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NEW YORK STATE LIBRARY
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(518) 474–5355 Fax: (518) 474–5786

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(701) 777–4632 Fax: (701) 777–3319

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Columbus, OH 43215–4163
(614) 644–7051 Fax: (614) 752–9178

OKLAHOMA

OKLAHOMA DEPT. OF LIBRARIES
U.S. Govt. Information Division
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(405) 521–2502, ext. 253
Fax: (405) 525–7804

OKLAHOMA STATE UNIV.
Edmon Low Library
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(405) 744–6546 Fax: (405) 744–5183

OREGON

PORTLAND STATE UNIV.
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Clemson, SC 29634–3001
(803) 656–5174 Fax: (803) 656–3025

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Columbia, SC 29208
(803) 777–4841 Fax: (803) 777–9503

TENNESSEE

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Merrill Library Documents Dept.
Logan, UT 84322–3000
(801) 797–2678 Fax: (801) 797–2677

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(804) 824–3133 Fax: (804) 924–4337

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(414) 286–3073 Fax: (414) 286–8074

Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
7. Abstract
8. Abstract Author
9. Subject Terms

SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

A Biweekly Publication of the National Aeronautics and Space Administration

VOLUME 37, AUGUST 16, 1999

01
AERONAUTICS (GENERAL)

19990053503 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia
Workshop on Helicopter Health and Usage Monitoring Systems
Forsyth, Graham F., Editor, Defence Science and Technology Organisation, Australia; February 1999; In English, February 1999, Melbourne, Australia; See also 19990053504 through 19990053520
Report No.(s): DSTO-GD-0197; AR-010-812; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Over the last 10 years, helicopter Health and Usage Monitoring Systems (HUMS) have moved from the research environment to being viable systems for fitment to civil and military helicopters. In the civil environment, the situation has reached the point where it has become a mandatory requirement for some classes of helicopters to have HUMS fitted. Military operators have lagged their civil counterparts in implementing HUMS, but that situation appears set to change with a rapid increase expected in their use in military helicopters. A DSTO-sponsored Workshop was held in Melbourne, Australia, in February 1999 to discuss the current status of helicopter HUMS and any issues of direct relevance to military helicopter operations.
Author
Conferences; Military Helicopters; Monitors

19990053516 Ministry of Defence, Directorate of Helicopter Projects, Bristol, UK
Fatigue Usage Monitoring in UK Military Helicopters
Draper, Alan, Ministry of Defence, UK; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 153-166; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

This paper describes the evolution of fatigue monitoring in UK military helicopters. The development of indirect mathematical relationships, to calculate fatigue damage from helicopter Health and Usage Monitoring System (HUMS) sensor data, is also discussed. The paper concludes with the concept of the Fatigue Usage Monitoring System (FUMS) management tool developed under contract from the MoD by MJA Dynamics, Hamble, UK.
Author
Fatigue (Materials); Military Helicopters; Monitors

19990053518 Naval Air Warfare Center, Propulsion and Power Dept., Patuxent River, MD USA
SH-60 Helicopter Integrated Diagnostic System (HIDS) Program Experience and Results of Seeded Fault Testing
Hess, Andrew J., Naval Air Warfare Center, USA; Hardman, Bill, Naval Air Warfare Center, USA; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 181-202; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

The evolution of automated diagnostic systems for helicopter mechanical systems has been aided by a Navy program of systematic testing of drive train components having known anomalies (seeded faults) while simultaneously executing a suite of diagnostic techniques to identify and classify the mechanical anomalies. This program, called the Helicopter Integrated Diagnostic System (HIDS) has been carried out using an iron bird test stand (SH-60) at NAWC - Trenton, and SH-60B/F flight vehicles at NAWC - Patuxent River. The SH-60 HIDS program has been the Navy's cornerstone effort to develop, demonstrate, and justify integrated mechanical diagnostic system capabilities for its helicopter fleets. The objectives of the program were to: 1. Acquire

raw data for multiple cases of ”good” and seeded fault mechanical components on a fully instrumented drive train to support the evaluation of diagnostic algorithms and fault isolation matrices. Data is being acquired from 32 vibration channels simultaneously at 100 kHz per channel while a continuous usage monitoring system records parametric steady state data from the power plant and airframe. 2. Analyze vibration and other diagnostic indicators to evaluate sensitivity and performance of all available diagnostic methods when analyzing well-documented parts. Evaluate relative effectiveness of these various diagnostic methods, indicators, and their associated algorithms to identify and optimize sensor location combinations. 3. Demonstrate the ability to integrate and automate the data acquisition, diagnostic, fault evaluation and communication processes in a flightworthy system. 4. Integrate and evaluate comprehensive engine monitoring, gearbox and drivetrain vibration diagnostics, advanced oil debris monitoring, inflight rotor track and balance, parts life usage tracking, automated flight regime recognition, power assurance checks and trending, and automated maintenance forecasting in a well coordinated on-board and ground-based system. 5. Provide an extensive library of high quality vibration data on baseline and seeded fault components. This data can be made available to anyone wanting to prove their diagnostic techniques or develop new capability. 6. Provide a ”showcase”, state-of-the-art, fully functional Integrated Mechanical Diagnostic system to act as a catalyst demonstration which might lead to interest in a fleet wide production application. This paper will describe the overall program, the goals and objectives, the facilities used, the system evaluated, the accomplishments and the results and conclusions obtained to date. The results of extensive gearbo and powertrain ”seeded fault” testing will be presented. Lessons learned which can be applied to future Helicopter Usage Monitoring Systems (HUMS) and/or Integrated Mechanical Diagnostic (IMD) systems will also be discussed.
Derived from text
Diagnosis; Faults; Helicopters; Performance Tests; Algorithms; Anomalies; Automatic Control

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also 34 Fluid Mechanics and Heat Transfer.

19990053521 Royal Aeronautical Society, London, UK
The Aeronautical Journal, Volume 103
Stollery, John L., Editor, Royal Aeronautical Society, UK; January 1999; ISSN 0001-9240; 68p; In English; See also 19990053522 through 19990053526; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ, UK), Hardcopy, Microfiche

Contents include the following: Unsteady aerodynamics: retrospect and prospect. Shock phenomena in high speed aerodynamics: still a source of major concern. Unsteady flow around helicopter rotor blade sections forward flight. Pressure over a two-cavity cascade at supersonic speed. and Wavelet analysis of pilot workload in helicopter low-level flying tasks.
CASI
Workloads (Psychophysiology); Wavelet Analysis; Unsteady Flow; Aerodynamics

19990053522 Defence Evaluation Research Agency, Bedford, UK
Unsteady Aerodynamics: Retrospect and Prospect
Mabey, D. G., Defence Evaluation Research Agency, UK; The Aeronautical Journal; January 1999; Volume 103, No. 1019, pp. 1-18; In English; See also 19990053521
Report No.(s): Paper-003; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ, UK), Hardcopy, Microfiche

This paper reviews some current problems in unsteady aerodynamics and discusses some future challenges. The emphasis is on problems associated with separated flows, such as buffeting and limit cycle oscillations. Suggestions are made to indicate how experimental facilities (such as cryogenic wind tunnels) and computational fluid dynamics might be exploited to address these questions.
Author
Buffeting; Cryogenic Wind Tunnels; Separated Flow; Unsteady Aerodynamics

19990053523 Office National d’Etudes et de Recherches Aerospatiales, Meundon, France
Shock Phenomena in High Speed Aerodynamics: Still a Source of Major Concern
Delery, J. M., Office National d’Etudes et de Recherches Aerospatiales, France; The Aeronautical Journal; January 1999; Volume 103, No. 1019, pp. 19-34; In English; See also 19990053521

Report No.(s): Paper-2434; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ, UK), Hardcopy, Microfiche

Shockwaves are present in a flow as soon as the Mach number becomes supersonic. Being viscous phenomena, shockwaves are a source of drag which can be predominant when the Mach number is significantly higher than one. In supersonic air intakes the production of entropy by shocks is felt as a loss in efficiency. At high Mach numbers, shockwaves produce a considerable temperature rise leading to severe heating problems, complicated by real gas effects. The intersection - or interference - of two shocks gives rise to complex wave patterns containing slip-lines and associated shear layers whose impingement on a nearby surface can cause detrimental pressure and heat transfer loads. The impact of a shockwave on a boundary layer is the origin of strong viscous interactions which remain a limiting factor in the design of transonic wings, supersonic air intakes, propulsive nozzles and compressor cascades. More effort is needed to improve prediction of these interactions and to devise new techniques to control such phenomena.

Author

Shock Waves; High Speed; Aerodynamics; Heat Transfer; Drag; Air Intakes

19990053524 Cranfield Univ., Coll. of Aeronautics, Bedford, UK

Unsteady Flow Around Helicopter Rotor Blade Sections in Forward Flight

Shaw, S. T., Cranfield Univ., UK; Qin, N., Cranfield Univ., UK; The Aeronautical Journal; January 1999; Volume 103, No. 1019, pp. 35-44; In English; See also 19990053521

Contract(s)/Grant(s): EPSRC-GR/K31664

Report No.(s): Paper-2329; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ, UK), Hardcopy, Microfiche

The aerodynamic performance of aerofoils performing unsteady motions its important for the design of helicopter rotors. In this respect the study of aerofoils undergoing in-plane oscillations (translation along the horizontal axis) provides useful insight h to the flow physics associated with the advancing blade in forward flight. Tn this paper a numerical method is developed in which the unsteady thin layer Navier-Stoke.s equations are solved for aerofoils performing rigid body motions. The method has been applied to the ca]eulation of the flowfield around a NACA 0012 aerofoil performing in-plane motions representative of high-speed forward flight. Comparison of computed pressure data with experimental measurements is generally found to be good. The quantitative differences observed between computations and experiment are thought to have arisen mainly as a consequence of the low aspect ratio of the model rotor employed in the wind tunnel tests.

Author

Unsteady Flow; Rotor Blades (Turbomachinery); Airfoils; Flight Characteristics; Fluid Dynamics

19990053525 Southampton Univ., Dept. of Aeronautics and Astronautics, UK

Pressure Over a Dual-Cavity Cascade at Supersonic Speeds

Zhang, X., Southampton Univ., UK; Edwards, J. A., Defence Evaluation Research Agency, UK; The Aeronautical Journal; January 1999; Volume 103, No. 1019, pp. 45-54; In English; See also 19990053521

Report No.(s): Paper-2378; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ, UK), Hardcopy, Microfiche

Pressure distributions over a dual cavity cascade were studied al supersonic speeds of Mach 1.5 and 2.5. The study was performed through numerical modelling and results comp.tred with model measurements. The Reynolds-averaged Navier-Stokes equations were solved using a finite-volume algorithm in which the inviscid cell interface fluxes were estimated using Roe's approximate Riemann solver with a second-order extension, and turbulence was modelled using a two-equation kappa-omega model with compressibility corrections. Two test configurations were selected: (1) a length-to-depth ratio L/D) = 1 cavity followed by another L /D = 1 cavity, and (2) an L/D = 3 cavity followed by an L/D = 1 cavity. The prediction was compared with that of a single cavity of the same L/D. It was found that the pressure field around the L/D = 1 cavity was substantially modified by a preceding L/D = 3 cavity. Changes in the pressure and pressure drag coefficient were observed. The study clarified some earlier observations of unsteady modes over a dual cavity cascade, and confirmed model measurements of the pressure fluctuation under a number of flow and geometry conditions.

Author

Pressure Distribution; Cavities; Supersonic Speed; Research; Aerodynamic Drag; Mathematical Models; Navier-Stokes Equation

19990053579 Duke Univ., School of Engineering, Durham, NC USA

Limit Cycle Oscillations (LCO) and Nonlinear Aeroelastic Wing Response: Reduced Order Aerodynamic Models ***Final Report, 1 Jul. 1995 - 30 Jun. 1998***

Dowell, Earl H.; Apr. 1999; 15p; In English

Contract(s)/Grant(s): F49620-95-1-0417; AF Proj. 3484

Report No.(s): AD-A362982; AFRL-SR-BL-TR-99-0125; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A nonlinear, aeroelastic analysis of a low aspect, delta wing modeled as a plate of constant thickness demonstrates that limit cycle oscillations (LCO) of the order of the plate thickness are possible. The structural nonlinearity arises from double bending in both the chordwise and spanwise directions. The present results using a vortex lattice aerodynamic model for a low Mach number flow complement earlier studies for rectangular wing platforms that showed similar qualitative results. The theoretical results for the flutter boundary (beyond which LCO occurs) have been validated by comparison to the experimental data reported by other investigators for the low aspect ratio delta wings. Also the limit cycle oscillations found experimentally by previous investigators (but not previously quantified prior to the present work) are consistent with the theoretical results reported here. Reduced order aerodynamic and structural models are used to substantially decrease computational cost with no loss in accuracy. Without the use of reduced order models, calculations of the LCO would be impractical. A wind tunnel model is tested to provide a quantitative experimental correlation with the theoretical results for the LCO response itself.

DTIC

Oscillations; Aeroelasticity; Aerodynamic Characteristics; Wind Tunnel Tests; Delta Wings

19990053582 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

Flow Visualisation about the Helicopter Deck of the Hydrographic Ship

Edwards, Craig D., Defence Science and Technology Organisation, Australia; March 1999; In English; Original contains color illustrations

Report No.(s): DSTO-TR-0762; AR-010-842; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Flow visualisation tests were performed about the helicopter deck of a 1/35 scale model of the Hydrographic Ship in the Low Speed Wind Tunnel at the Aeronautical and Maritime Research Laboratory. The model was tested over a range of relative wind angles using tuft, smoke and surface flow visualisation techniques to determine regions of adverse airflow that may have a detrimental effect on helicopter-ship operations in order to meet certification requirements. In particular, turbulent flow in the vicinity of the flight deck, vertical replenishment area and the ship's anemometer installation were identified, photographed and recorded on video. Effects of two fixed ship roll angles on the flow were also investigated. This document contains extensive results for all model configurations tested and describes in detail the flow features observed.

Author

Flow Visualization; Performance Tests; Turbulent Flow; Scale Models; Hydrography; Helicopters; Air Flow

19990053900 Department of the Navy, Washington, DC USA

Articulated Fin

Nedderman, William H., Jr., Inventor; Nov. 24, 1998; 6p; In English; Supersedes US-Patent-Appl-SN-668605, AD-D018073.

Patent Info.: Filed 3 Jun. 96,; US-Patent-Appl-SN-668,605; US-Patent-5,839-700

Report No.(s): AD-D019325; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

An articulated fin of the present invention includes a nose section, a tail section, an upper flexible control surface, and a lower flexible control surface. The upper and lower flexible control surfaces each span from the tail section to the nose section. The fin further includes a gear assembly for applying compressive and tensile forces on the upper and lower flexible control surfaces. The gear assembly bends the tail section upwardly upon applying a tensile force on the upper flexible control surface and a compression force on the lower flexible control surface, and bends the tail section downwardly upon applying a compression force on the upper flexible control surface and a tensile force on the lower flexible control surface.

DTIC

Aerodynamic Characteristics; Fins; Compressibility

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also 16 Space Transportation and 85 Urban Technology and Transportation.

19990054051 NASA Glenn Research Center, Cleveland, OH USA
Detecting the Onset of Fire in an Aircraft by Employing Correlation Spectroscopy
Goswami, Kisholoy, Intelligent Optical Systems, Inc., USA; Saxena, Indu, Intelligent Optical Systems, Inc., USA; Egalon, Claudio, Intelligent Optical Systems, Inc., USA; Mendoza, Edgar, Intelligent Optical Systems, Inc., USA; Lieberman, Robert, Intelligent Optical Systems, Inc., USA; Piltch, Nancy D., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 376-377; In English; See also 19990053965
Contract(s)/Grant(s): NAS3-99030; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The cause of aircraft fire and locations of the fires are numerous. Worldwide, numerous in-flight fires have been passenger initiated, the prime location being the lavatory areas. Most in-flight fires in commercial carriers are of electrical origin and cigarettes. A cargo bay fire can be caused by a variety of reasons. The sheer number of different types of cargo makes it difficult to identify the origin, especially when the fire reaches the catastrophic level. The damage can be minimized, and fire can be suppressed effectively if a warning system for the onset of fire is available for onboard monitoring.
Derived from text
Aircraft Safety; Warning Systems; Combustion Products; Correlation Detection

19990054193 Federal Aviation Administration, Washington, DC USA
Notices to Airmen Domestic/International, February 25, 1999
Dec. 31, 1999; 230p; In English
Report No.(s): PB99-137150; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Topic discussed include the following: Airway Notams; Airports, Facilities and Procedural Notams; General FDC Notams; Part 95 Revisions to Minimum en Route IFR Altitudes and Changeover Points; International Notices to Airmen; and Graphic Notices.
NTIS
Air Navigation; Runways; Airports; Navigation Aids; Flight Paths

19990054448 Bureau of Transportation Statistics, Office of Airline Information, Washington, DC USA
Air Carrier Reporting Punctuality Assessment. Accounting and Reporting Directive
Feb. 25, 1999; 14p; In English
Report No.(s): PB99-144172; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Office of Airline Information reissues its 'Air Carrier Reporting Punctuality Assessment' report. The report was originally issued on January 26, 1999. The report covered the period from July 1, 1998, through December 31, 1998. The original report misstated the days late for several air carriers. This revised report contains seven tables showing the timeliness factor for each air carrier's recurrent reporting.
NTIS
Air Transportation; Airline Operations

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 17 Space Communications, Spacecraft Communications, Command and Tracking and 32 Communications and Radar.

19990053728 Naval Surface Warfare Center, Dahlgren Div., Dahlgren, VA USA
An Evaluation of Precise Absolute Navigation (PAN) Performance Under Dynamic Conditions ***Final Report***
Hermann, Bruce R.; Jan. 1999; 39p; In English
Report No.(s): AD-A362733; NSWCDD/TR-98/113; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes a method where the Global Positioning System (GPS) Precise Positioning Service (PPS) solutions recorded in the field can be reprocessed at a later time with the precise ephemerides, without requiring that the observations be

saved. The reprocessing with the precise ephemerides improves the quality of the navigation solutions compared with the solutions obtained when the real-time broadcast ephemerides are used. This report continues the investigation of the Precise Absolute Navigation (PAN) technique by exploring its accuracy under two particular conditions. The first condition is operation with single-frequency observations and use of the broadcast ionospheric model; the second is when the user experiences appreciable height variations due to his motion, as in an aircraft. Also demonstrated are the accuracy of PAN solutions to simulated observations from a high-altitude, low-speed platform, such as an Unmanned Aerial Vehicle (UAV).
DTIC
Air Navigation; Global Positioning System; Atmospheric Models; Earth Ionosphere; Navigation

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology. For related information see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles see 85 Urban Technology and Transportation.

19990053504 Goodrich (B. F.) Aerospace, Simulation and Algorithm Development Center, Bedford, MA USA
Integrated Mechanical Diagnostics (IMD) Health Usage and Management System(HUMS)
Gill, John, Goodrich (B. F.) Aerospace, USA; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 7-15; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

The USA Navy and USA Marines, in partnership with BFGoodrich Aerospace, have embarked upon an ambitious program to improve operational readiness and flight safety while slashing maintenance-related costs. That HUMS program is now on the cusp of an important milestone - installation of the first fully functional system on two aircraft types, the SH-60B support helicopter and the CH-53E cargo helicopter. The system has evolved under Joint Dual-Use Program Office's (JDUPO) Commercial Operations and Support Savings Initiative (COSSI) and is now referred to as IMD-HUMS. This paper presents the system's current state of evolution and outlines how the system will continue to evolve as we strive to achieve fleet-wide deployment. This paper will describe the components and processes that make up the fully functional and integrated system. It will also outline the near term implementation plan to prepare for eventual transition from initial installation to fleet-wide deployment.
Derived from text
Flight Safety; Maintainability; Installing; Helicopters; Diagnosis

19990053505 Helitune Ltd., Malvern, UK
Modular Distributed HUMS: An Overview
Mowbray, Keith, Helitune Ltd., UK; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 17-22; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Contents include the following: Defining the system; HUMS requirements; The common modules; Availability; On board laser tracker; Basic system configuration; All up system configuration; Distributed modular HUMS; Engine HUMS functions; and Transmission HUMS functions.
CASI
Management Systems; Electronic Modules; Availability; Performance Prediction

19990053506 Smiths Industries, Inc., Grand Rapids, MI USA
UK Ministry of Defence Health and Usage Monitoring System (HUMS)
Trammel, Charles, Smiths Industries, Inc., USA; Vossler, Gerald, Smiths Industries, Inc., USA; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 23-41; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

The Health and Usage Monitoring System (HUMS) have been designed with building block approach to allow easy configuration for: Cockpit Voice and Flight Data Recorder (CVFDR) operation; Usage and exceedance monitoring; Rotor Track and Balance (RTB); Airframe Vibration Monitoring (AVM); Transmission Vibration Monitoring (TVM); and Engine Vibration Monitoring (EVM). The UK HUMS Chinook Program will: Tailor and qualify airborne and ground systems, and Provide an Aircraft Design Authority (ADA) approved installation design.
Derived from text
Monitors; Aerodynamic Balance; Aircraft Design; Flight Recorders; Health

19990053507 Chadwick-Helmuth Co., Inc., El Monte, CA USA

Health Monitoring of Helicopters: Applications and Achievements

Dobrin, Lawrence L., Chadwick-Helmuth Co., Inc., USA; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 43-48; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

History has taught us that the growth of helicopter health monitoring has been more evolutionary that revolutionary. Only the most sophisticated of helicopter operators whether it be military or commercial invests in the manpower and training to incorporate some of the software tools made available by ”HUMS” suppliers. Developmental offerings of prospective products and claims of dramatic benefits are in most instances unrealized. As events unfold, we are seeing that permanent on-board monitoring of basic helicopter functions are nevertheless yielding significant benefits, largely from availability of continuous recorded data for both immediate light line usage and also for post flight analysis. The most fundamental of monitoring functions; that of rotor track and balance is yielding important information regarding not only the rotor system but that of associated components. The extension of rotor track and balance basics yields important clues as to how carefully applied diagnostics to other rotating components can similarly benefit from the more intensive examination of newly available data. This paper will present some of the findings that are now possible and the conclusions as to how expansion of basics can lead to a more powerful operational utility of health monitoring tools.

Derived from text

Aerodynamic Balance; Health; Helicopters; Postflight Analysis; Rotary Wings

19990053508 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

Vibration Monitoring of Royal Australian Navy Helicopters

Blunt, David, Defence Science and Technology Organisation, Australia; ONeill, Peter, Royal Australian Navy, Australia; Rebbechi, Brian, Defence Science and Technology Organisation, Australia; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 49-56; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

This paper provides a brief background of helicopter vibration monitoring in the , and describes the integrated vibration monitoring system currently being introduced into their fleet of S-70B-2 Seahawk and SK-50 Sea King helicopters. The system incorporates standard commercial airframe rotor track and balance equipment, and an AMRL - developed transmission vibration monitoring system. Both incorporate permanently mounted sensors wired to cabin receptacles, and carry-on / carry-off vibration analysers.

Author

Vibration; Monitors; Sh-3 Helicopter; Aerodynamic Balance

19990053511 Vibro-Meter S.A., Fribourg, Switzerland

ROTABS(trademark): Re-Writing the Manual on Rotor Track and Balance

Cant, Robert, Vibro-Meter S.A., Switzerland; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 89-98; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

ROTABS(TM) is an integral part of the eurocopter aircraft recording and monitoring system EUROARMS. It is more comprehensive system. It has superior balance result. Also simplified /safer operation and has high reliability stand - alone or integrated system.

CASI

Monitors; Automatic Control; Military Helicopters

19990053515 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne, Australia

Helicopter Structural Usage Monitoring Work at DSTO Airframes and Engines Division

Lombardo, Domenico, Defence Science and Technology Organisation, Australia; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 137-151; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Pilot Questionnaire data used to create new usage spectrum for Australian Black Hawk. Quantitative program proposed for measuring Black Hawk usage, Usage monitoring research looking at: economic effectiveness of usage monitoring - estimation

of gross Weight from indirect measurement; and application of Al techniques to examine problems of identifying flight conditions with minimal information.
CASI
Airframes; Helicopters; Monitors; Engine Control

19990053517 Aerostructures, Inc., Arlington, VA USA
Helicopter Usage Monitoring Using the MaxLife System
White, David, Aerostructures, Inc., USA; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 167-179; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Contents include the following: Overview of Aerostructures; Specialized Usage Monitoring Expertise; AH-1W Usage Monitoring Results; and MaxLife System and Programs.
CASI
Monitors; AH-1W Helicopter; Life (Durability); Damage Assessment

19990053520 Analysis, Management and Systems (Pty) Ltd., South Africa
Health and Usage Monitoring System for the Hawk Aircraft
Havinga, M. C., Analysis, Management and Systems (Pty) Ltd., South Africa; Botes, C. J., Analysis, Management and Systems (Pty) Ltd., South Africa; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 217-225; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

This paper describes the Health and Usage Monitoring System for the Hawk aircraft supplied to the Royal Australian Air Force. British Aerospace MA&A placed a contract upon AMS for the development of a HUMS with the following functionality: (a) Avionics equipment health monitoring. (b) Flight data recording in crash protected memory. (c) Cockpit voice data recording in crash protected memory. (d) An airframe fatigue monitoring system. (e) Low cycle fatigue monitoring of the engine. Health Monitoring is conducted by the sampling and storage of avionics equipment built-in test data. When a failure occurs the relevant environmental data is stored which allows detailed analysis of failure conditions on the aircraft. In addition, failure discretes as asserted by the OBOGS are monitored and stored by the HUMS. Airframe Usage Monitoring is conducted by sampling and processing of strain gauges mounted at key locations within the aircraft. Engine Usage Monitoring is conducted by the sampling and processing of key engine parameters sampled from engine and aircraft sensors. The HUMS consists of a Data Acquisition Unit, a Crash Survivable Memory Unit, a Flightline System and a Desktop System. The Data Acquisition Unit samples, processes and stores data from sensors and aircraft equipment. It formats and transmits flight data to the Crash Survivable Memory Unit. All stored data is transmitted to the Flightline System during upload and download operations at the aircraft flightline. The Crash Survivable Memory Unit receives formatted flight data frames for the Data Acquisition Unit and samples voice data from the Cockpit Audio Management Unit and stores this data in crash protected memory.
Author
Health; Aircraft Equipment; Airframes; Crashes; Data Acquisition; Failure

19990053566 Dayton Univ. Research Inst., Research Inst., OH USA
Update of the Probability of Fracture (PROF) Computer Program for Aging Aircraft Risk Analysis, Volume 1, Modifications and User's Guide ***Final Report, Sep. 1996 - Nov. 1998***
Hovey, Peter W.; Berens, Alan P.; Loomis, John S.; Nov. 1998; 92p; In English
Contract(s)/Grant(s): F09603-95-D-0175; AF Proj. FAAF
Report No.(s): AD-A363010; UDR-TR-1998-00154-VOL-1; AFRL-VA-WP-TR-1999-3030; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The computer program, Probability of Fracture (PROF) was written to facilitate the Air Force implementation of structural risk analyses. The fracture probabilities from a PROF run directly complement the deterministic damage tolerance analyses that form the bases for structural maintenance actions. However, there are many structural scenarios that cannot be modeled directly by a single PROF run, but can be analyzed through the combination of multiple PROF runs. These include the scenarios introduced by widespread fatigue damage and corrosive thinning. While these more complex applications of PROF have been demonstrated, they were difficult to implement because of the post processing required of the individual PROF runs. Further, to accommodate the calculation of failure due to discrete source damage in the presence of widespread fatigue damage, a different failure criterion was needed. Therefore, PROF was updated to accommodate these calculations and to incorporate more robust computational

algorithms. This report describes the modifications made to PROF and serves as a users guide for the program. Volume 2 is a programmers guide to the PROF software.
DTIC
Probability Theory; Risk; Structural Analysis; User Manuals (Computer Programs); Aging (Metallurgy); Cracking (Fracturing)

19990053655 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Melbourne Australia
Residual Stress Measurements and Boeing Wedge Durability Data for the Proposed 470 Bulkhead Bonded Repair
Olsson-Jacques, Christina; Nov. 1998; 32p; In English
Report No.(s): AD-A361706; DSTO-TN-0178; DODA-AR-010-675; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Fatigue cracking problems have occurred in the F/A-18 470.5 bulkhead during initial full scale testing. The surface of this bulkhead is shot-peened to introduce compressive residual stress to increase the fatigue life of the component as part of the manufacturing and maintenance program. The Aeronautical and Maritime Research Laboratory (AMRL) is investigating the effect of applying a composite patch to reduce the critical strains in the crotch area. Boeing wedge durability tests were used to define the most suitable metal preparation procedure to apply a durable patch to a shotpeened aluminium alloy surface. The x-ray diffraction technique was used to assess any reduction in the beneficial shot-peened residual stress after typical abrasion and heat treatment stages in the preparation procedure. It was found that the abrasion and heat treatment processes used to achieve the most durable surface treatment for bonding did not significantly reduce the beneficial compressive surface stresses induced by the shot-peening process.
DTIC
Aircraft Maintenance; Bonded Joints; Bulkheads; Fatigue Life; Crack Propagation; Residual Stress; Adhesive Bonding; Metal Surfaces; Stress Measurement; Shot Peening

19990053656 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Unmanned Aerial Vehicle Mission Level Simulation
Walston, Jennifer G.; Mar. 1999; 73p; In English
Report No.(s): AD-A361707; AFIT/GOR/ENS/99M-17; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We develop an object-oriented simulation that models the surveillance and Active Suppression of Enemy Air Defense (SEAD) missions of the Unmanned Aerial Vehicle (UAV) RQ-1A Predator. The simulation, written in Java using the Silk simulation package, interfaces with a Reactive Tabu Search routing algorithm to provide optimal UAV routes. The routing algorithm is called by the simulation to account for changes in weather conditions and to provide a means of dynamically retasking the UAV. The simulation and analysis support a UAV Battlelab initiative to test the operational effects of proposed changes in Predator performance and UAV capability to perform in an Active SEAD mission. Analysis efforts examine the effect of speed, endurance, and weather susceptibility on UAV operational effectiveness and the effects of radar cross section, threat density, and threat lethality on UAV Active SEAD mission performance.
DTIC
Pilotless Aircraft; Object-Oriented Programming; Computerized Simulation; Flight Simulation; Aerial Reconnaissance; Routes

19990053657 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Dynamic Unmanned Aerial Vehicle (UAV) Routing with a Java-Encoded Reactive Tabu Search Metaheuristic
ORourke, Kevin P.; Mar. 1999; 131p; In English
Report No.(s): AD-A361708; AFIT/GOA/ENS/99M-06; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

In this paper we consider the dynamic routing of unmanned aerial vehicles (UAVs) currently in operational use with the US Air Force. Dynamic vehicle routing problems (VRP) have always been challenging, and the airborne version of the VRP adds dimensions and difficulties not present in typical ground-based applications. Previous UAV routing work has focused on primarily on static, pre-planned situations; however, scheduling military operations, which are often ad-hoc, drives the need for a dynamic route solver that can respond to rapidly evolving problem constraints. With these considerations in mind, we examine the use of a Java-encoded metaheuristic to solve these dynamic routing problems, explore its operation with several general problem classes, and look at the advantages it provides in sample UAV routing problems. The end routine provides routing information for a UAV virtual battlespace simulation and allows dynamic routing of operational missions.
DTIC
Pilotless Aircraft; Heuristic Methods; Traveling Salesman Problem; Dynamic Programming; Object-Oriented Programming; Java (Programming Language); Routes; Flight Plans

19990053664 Federal Aviation Administration, Airport and Aircraft Safety Research and Development Div., Atlantic City, NJ USA

Comparison of Boundary Correction Factor Solutions for Two Symmetric Cracks in a Straight-Shank Hole ***Final Report***

Bakuckas, J. G.; Apr. 1999; 30p; In English

Report No.(s): PB99-147399; DOT/FAA/AR-98/36; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report compares the mode I boundary correction factor solutions for two symmetric elliptical cracks emanating from a straight-shank hole. A global-intermediate-local (GIL) hierarchical approach was developed using the finite element method (FEM). Comparisons were made with the following methods: the FEM with the equivalent domain integral, semiempirical boundary correction factor equations, the finite element alternating method, the boundary element method with the crack opening displacement approach, the boundary element method using special crack-tip elements, and the three-dimensional weight function method.

NTIS

Boundary Element Method; Cracking (Fracturing); Correlation

19990053793 APR Consultants, Inc., Medway, OH USA

A Practical Method for Aircraft Life Enhancement ***Final Report***

May 1998; 26p; In English

Contract(s)/Grant(s): F33615-97-C-3214

Report No.(s): AD-A362642; STTR-97-142; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this Phase I effort was to prove the feasibility of reducing dynamic loads induced into aircraft structure by increasing landing gear strut precharge pressure. Reducing dynamic loads will reduce fatigue damage to aircraft structure resulting in life extension and reduced maintenance and inspections. An additional purpose of this effort was to determine the ”degree” of life enhancement that can be achieved. Finally, commercial aircraft operations and maintenance organizations were contacted to determine the level of ground loads related problems that occur in day to day operations. A NASA Langley instrumented A-6 main landing gear strut was used to experimentally validate the concept. Computer simulations were used to predict dynamic load reductions for a large matrix of conditions for a variety of aircraft. The computer predictions were used to assess the potential life enhancement that could be achieved. Questionnaires were sent to a variety of commercial airline organizations requesting information regarding maintenance, inspection and structural failure data that relate to this effort. Phase I of this effort proved conclusively (both analytically and experimentally) that ground loads can be reduced by 40% or more by increasing strut precharge pressure. Estimated improvements in life of up to 15% were calculated for a randomly selected structure. A ”hot spot” would show much greater improvement. The results of Phase I were better than anticipated. The application of this technology will include military and civilian aircraft. The aircraft that will benefit the most will be large flexible aircraft such as commercial jets and military bomber and cargo aircraft that operate heavy and on rough runways.

DTIC

Dynamic Loads; Aircraft Structures; Fatigue (Materials); Structural Failure; Struts

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 44 Energy Production and Conversion.

19990053514 Howard (Paul L.), Newmarket, NH USA

A Straw Man for the Integration of Vibration and Oil Debris Technologies

Howard, Paul L., Howard (Paul L.), USA; Reintjes, John, Naval Research Lab., USA; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 131-136; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Diagnosis of faults in mechanical systems has traditionally involved analysis of vibration data and analysis of oil borne debris captured by magnets placed in the lubricating oil stream and has relied heavily upon trained expert analysis of data. Because the technologies are expert intensive and quite different in practice, they have remained basically separate analytical technologies. Each technology requires specific expert interpretation of data. Generally, neither answers the question ”what’s failing and how bad is it?”. Data in ”g’s rms.” and ”parts per million of iron” will normally be compared to limit values. This usually occasions review by a trained technician to determine the course of action to be followed and may or may not signal the existence of a prob-

lem. Optical analysis of oil borne debris by experienced technicians can provide additional information on machine condition well in advance of failure, but the accuracy of the analysis is still highly dependent on the capability of the human expert. Attempts to automate these analysis processes have mostly been rewarded by a high incidence of false alarms. Operators of early HUMS systems overcame these limitations by employing human expert analysis of data. Sometimes multiple indications were required before a problem was recognized. Currently HUMS systems must rely almost exclusively upon vibration analysis for detection of most faults, partly because automation of oil debris analysis has fallen behind basic HUMS technology development. While some of the critical HUMS detectable faults do not produce significant levels of oil borne debris, there are many that do. Reliance on prior technology, such as chip detectors and particle sensors / counters, has not allowed development of a truly robust, low false alarm rate, mechanical diagnostic system. New oil debris technology, such as LaserNet, which directly identifies the surface fatigue fault mode(s) from particle shape, can assess severity, and trend growth of significant faults could provide a way forward for integration of vibration and oil debris technologies to produce a superior diagnostic approach. This paper identifies some current technology roadblocks and offers a straw man framework for such an integration process.
Derived from text
Failure; Dynamic Structural Analysis; Lubricating Oils; False Alarms

19990053519 Institute for Aerospace Research, Ottawa, Ontario Canada
Developments in Non-Intrusive Diagnostics for Engine Condition Monitoring
Bird, Jeff W., Institute for Aerospace Research, Canada; Mulligan, M. F., Institute for Aerospace Research, Canada; MacLeod, J. D., Institute for Aerospace Research, Canada; Little, D., National Defence Headquarters, Canada; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 203-216; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Knowledge of the condition of a gas turbine engine is essential for both flight safety and cost effective operations, particularly in the military environment with severe operating conditions, critical missions and limited fleets. One option is for military operators to look for new engine condition assessment tools However, these tools must be practical for use on an operational base or at least in an overhaul centre, if real benefits are to be seen. Non-intrusive sensors using thermal radiation and spectroscopic analysis appear as promising technologies. The Institute for Aerospace Research of the National Research Council of Canada is working with the Canadian Department of National Defence to assess the effectiveness of these two, engine condition monitoring methods. The real-time, online capabilities of these two methods are of particular interest. Results of bench and implanted fault studies are shown for the infrared thermography study, demonstrating fault isolation in a test cell environment. Limited implanted fault tests with actual turbine rubs in a J85 turbojet are also reported to demonstrate early promising results for the use of spectroscopy. Field usage assessments are a key part of the overall project; some details are given of the use of the thermography tool at an overhaul centre and also on the flight line.
Author
Nonintrusive Measurement; Turbojet Engines; Faults; Diagnosis; Gas Turbine Engines

19990053567 Naval Postgraduate School, Monterey, CA USA
Thrust Augmentation for a Small Turbojet Engine
Hackaday, Gary L.; Mar. 1999; 90p; In English
Report No.(s): AD-A362981; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A Sophia J450 (nine pounds of thrust) gas turbine engine was used first to examine the thrust augmentation generated using an ejector shroud. Experimental results obtained with and without the ejector were compared with performance predicted using an engine code and a one-dimensional ejector analysis. The engine code was revised to incorporate a radial turbine and the correct compressor map. Thrust augmentation of 3-10% was measured and the trends were correctly predicted. Second, an engine shroud was designed and installed around the engine and flow measurements were conducted to determine the entrainment rate in the shroud. The engine shroud was the initial step toward designing a turboramjet.
DTIC
Thrust Augmentation; Turboramjet Engines; Aircraft Engines; Gas Turbines

19990054416 Johns Hopkins Univ., Whiting School of Engineering, Columbia, MD USA
JANNAF Airbreathing Propulsion Subcommittee and 35th Combustion Subcommittee Meeting, Volume 1
Fry, Ronald S.; Gannaway, Mary T.; Rognan, Melanie; Dec. 1998; 73p; In English, 7-11 Dec. 1998, Tucson, AZ, USA
Contract(s)/Grant(s): SP0700-97-D-4004
Report No.(s): AD-A363687; CPIA-PUB-682-VOL-1; No Copyright; Avail: Availability: CPIA, 10630 Little Patuxent Parkway,

Suite 202, Columbia, MD 21044-3204, Microfiche

This document, CPIA Publication 682, Volume I, is a compilation of 5 unclassified/unlimited technical papers (approved for public release) which were presented at the 1 998 meeting of the Joint Army-Navy-NASA-Air Force (JANNAF) Airbreathing Propulsion Subcommittee (APS) and Combustion Subcommittee (CS) held jointly with the Propulsion Systems Hazards Subcommittee (PSHS). The meeting was held on 7-11 December 1998 at Raytheon Systems Company and the Marriott Hotel, Tucson, AZ. Topics covered include HyTech technology development, hydrocarbon fuel development for hypersonic applications, pulse detonation propulsion system development and arc heaters for direct-connect scramjet testing.

DTIC

Air Breathing Engines; Propulsion System Configurations; Propulsion System Performance; Hydrocarbon Fuels; Systems Engineering

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also 05 Aircraft Design, Testing and Performance.

19990054417 Ohio State Univ., Dept. of Aerospace Engineering Applied Mechanics and Aviation, Columbus, OH USA

New Control Design Techniques Tailored to Smart Structural Systems ***Final Report, 5 May 1997 - 5 Jun. 1998***

Yedavalli, R. K.; Nov. 1998; 48p; In English

Contract(s)/Grant(s): F33615-97-1-3207; AF Proj. 2302

Report No.(s): AD-A363850; AFRL-VA-WP-TR-1998-3080; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this research, a new observer based control design specifically tailored to smart aeroelastic systems is presented. This truly multi-disciplinary system of an elastic structure with piezoelectric actuating and sensing under external aerodynamic load is modeled with an integrated finite element method. A new control design algorithm based on

DTIC

Piezoelectricity; Finite Element Method; Detection; Control Systems Design

19990054645 NASA Langley Research Center, Hampton, VA USA

Transonic Flutter Suppression Control Law Design, Analysis and Wind-Tunnel Results

Mukhopadhyay, Vivek, NASA Langley Research Center, USA; 1999; In English; Aeroelasticity and Structural Dynamics 1999, 22-25 Jun. 1999, Williamsburg, VA, USA

Report No.(s): IFA-1999; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The benchmark active controls technology and wind tunnel test program at NASA Langley Research Center was started with the objective to investigate the nonlinear, unsteady aerodynamics and active flutter suppression of wings in transonic flow. The paper will present the flutter suppression control law design process, numerical nonlinear simulation and wind tunnel test results for the NACA 0012 benchmark active control wing model. The flutter suppression control law design processes using (1) classical, (2) linear quadratic Gaussian (LQG), and (3) minimax techniques are described. A unified general formulation and solution for the LQG and minimax approaches, based on the steady state differential game theory is presented. Design considerations for improving the control law robustness and digital implementation are outlined. It was shown that simple control laws when properly designed based on physical principles, can suppress flutter with limited control power even in the presence of transonic shocks and flow separation. In wind tunnel tests in air and heavy gas medium, the closed-loop flutter dynamic pressure was increased to the tunnel upper limit of 200 psf. The control law robustness and performance predictions were verified in highly nonlinear flow conditions, gain and phase perturbations, and spoiler deployment. A non-design plunge instability condition was also successfully suppressed.

Author

Transonic Flutter; Control Theory; Design Analysis; Wind Tunnel Tests; Nonlinearity; Unsteady Aerodynamics; Retarding

16
SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. for related information see also 03 Air Transportation and Safety and 18 Spacecraft Design, Testing and Performance. For space suits see 54 Man/System Technology and Life Support

19990053884 NASA Johnson Space Center, Houston, TX USA
NASA Orbiter Extended Nose Landing Gear
King, Steven R., Lockheed Martin Corp., USA; Jensen, Scott A., Lockheed Martin Corp., USA; Hansen, Christopher P., NASA Johnson Space Center, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 373-387; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper discusses the design, development, test, and evaluation of a prototype Extended Nose Landing Gear (ENLG) for NASA's Space Shuttle orbiters. The ENLG is a proposed orbiter modification developed in-house at NASA's Johnson Space Center (JSC) by a joint government/industry team. It increases the orbiter's nose landing gear (NLG) length, thereby changing the vehicle's angle of attack during rollout, which lowers the aerodynamic forces on the vehicle. This, in combination with a dynamic elevon change, will lower the loads on the orbiter's main landing gear (MLG). The extension is accomplished by adding a telescoping section to the current NLG strut that will be pneumatically extended during NLG deployment.
Author
Space Shuttle Orbiters; Landing Gear; Spacecraft Landing; Spacecraft Components; Systems Engineering; Mechanical Devices

19990053904 NASA Langley Research Center, Hampton, VA USA
Dan Goldin Presentation: Pathway to the Future
Apr. 05, 1999; In English; Videotape: 87 min. 30 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-1999064054; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

In the "Path to the Future" presentation held at NASA's Langley Center on March 31, 1999, NASA's Administrator Daniel S. Goldin outlined the future direction and strategies of NASA in relation to the general space exploration enterprise. NASA's Vision, Future System Characteristics, Evolutions of Engineering, and Revolutionary Changes are the four main topics of the presentation. In part one, the Administrator talks in detail about NASA's vision in relation to the NASA Strategic Activities that are Space Science, Earth Science, Human Exploration, and Aeronautics & Space Transportation. Topics discussed in this section include: space science for the 21st century, flying in mars atmosphere (mars plane), exploring new worlds, interplanetary internets, earth observation and measurements, distributed information-system-in-the-sky, science enabling understanding and application, space station, microgravity, science and exploration strategies, human mars mission, advance space transportation program, general aviation revitalization, and reusable launch vehicles. In part two, he briefly talks about the future system characteristics. He discusses major system characteristics like resiliencey, self-sufficiency, high distribution, ultra-efficiency, and autonomy and the necessity to overcome any distance, time, and extreme environment barriers. Part three of Mr. Goldin's talk deals with engineering evolution, mainly evolution in the Computer Aided Design (CAD)/Computer Aided Engineering (CAE) systems. These systems include computer aided drafting, computerized solid models, virtual product development (VPD) systems, networked VPD systems, and knowledge enriched networked VPD systems. In part four, the last part, the Administrator talks about the need for revolutionary changes in communication and networking areas of a system. According to the administrator, the four major areas that need cultural changes in the creativity process are human-centered computing, an infrastructure for distributed collaboration, rapid synthesis and simulation tools, and life-cycle integration and validation. Mr. Goldin concludes his presentation with the following maxim "Collaborate, Integrate, Innovate or Stagnate and Evaporate." He also answers some questions after the presentation.
CASI
Conferences; NASA Programs; Mission Planning; Technological Forecasting; Systems Engineering; Aerospace Sciences; Space Exploration

19990054654 NASA Johnson Space Center, Houston, TX USA
STS-96 Mission Highlights, Part 1
Jul. 07, 1999; In English; Videotape: 50 min. 30 sec. playing time, in color, with sound
Report No.(s): JSC-1790/PT1; NONP-NASA-VT-1999087306; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

In this first part of a three-part video mission-highlights set, the flight of the STS-96 Space Shuttle Orbiter Discovery is reviewed. The flight crew consists of Kent V. Rominger, Commander; Rick D. Husband, Pilot; and Mission Specialists Ellen

Ochoa, Tamara E. Jernigan, Daniel T. Barry, Julie Payette (Canadian), and Valery Ivanovich Tokarev (Russian). The primary goals of this mission were to work on logistics and resupply the International Space Station (ISS). This is the first flight to dock to the International Space Station. The primary payloads are the Russian cargo crane, known as STRELA, which the astronauts mount to the exterior of the Russian station segment, the SPACEHAB Oceaneering Space System Box (SHOSS), and a U.S. built crane called the ORU Transfer Device (OTD). Other payloads include the Student Tracked Atmospheric Research Satellite for Heuristic International Networking Equipment (STARSHINE), the Shuttle Vibration Forces Experiment (SVF), and the Orbiter Integrated Vehicle Health Monitoring - HEDS Technology Demonstration (IVHM HTD). The traditional pre-launch breakfast, being suited up, entry into the Shuttle, and views of the liftoff from several different vantage points are shown. In-flight footage includes views from the robot arm conducting a television survey of Discovery's payload bay and the flawless docking of the Unity module with the International Space Station. During the docking, camera views from both the ISS and Discovery are presented. These activities make up the first three Flight Days of STS-96.
CASI
Discovery (Orbiter); Space Shuttle Missions; International Space Station; Spacecraft Docking; Spacecrews

19990054655 NASA Johnson Space Center, Houston, TX USA
STS-96 Mission Highlights, Part 2
Jul. 07, 1999; In English; Videotape: 55 min. 51 sec. playing time, in color, with sound
Report No.(s): JSC-1790/PT2; NONP-NASA-VT-1999087307; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

In this second part of a three-part video mission-highlights set, on-orbit spacecrew activities performed on the STS-96 Space Shuttle Orbiter Discovery and the International Space Station are reviewed. The flight crew consists of Kent V. Rominger, Commander; Rick D. Husband, Pilot; and Mission Specialists Ellen Ochoa, Tamara E. Jernigan, Daniel T. Barry, Julie Payette (Canadian), and Valery Ivanovich Tokarev (Russian). The primary goals of this mission were to work on logistics and resupply the International Space Station. This second part in the mission series features video from Flight Day 4-7 (FD 4-7). FD 4 of STS-96 presents astronauts Tammy Jernigan and Dan Barry completing the second longest space walk in shuttle history. Footage includes Jernigan and Barry transferring and installing two cranes from the shuttle's payload bay to locations on the outside of the station. The astronauts enter the International Space Station delivering supplies and prepare the outpost to receive its first resident crew, scheduled to arrive in early 2000 on FD 5. The video also captures the crew involved in logistics transfer activities within the Discovery/ISS orbiting complex. FD 6 includes footage of Valery Tokarev and Canadian astronaut Julie Payette charging out the final six battery recharge controller units for two of Zarya's power-producing batteries and all crew members' involvement in logistics transfer activities from the SPACEHAB module to designated locations in the International Space Station. With the transfer work of FD 6 all but complete, the astronauts conduct some additional work, installing parts of a wireless strain gauge system that will help engineers track the effects of adding modules to the station throughout its assembly. Moving the few remaining items from Discovery to the ISS, then closing a series of hatches within the station's modules leading back to the shuttle are the primary activities contained in FD 7. Final coverage features Discovery's astronauts finishing their work inside the International Space Station, closing all of the hatches and readying the shuttle's small thrusters to be fired to raise the entire complex's orbit in preparation for the undocking and departure set for FD 8.
CASI
Discovery (Orbiter); Space Shuttle Missions; International Space Station; Spacecrews; Spacecraft Maintenance; Extravehicular Activity; Spacecraft Modules; Space Shuttle Payloads

19990054656 NASA Johnson Space Center, Houston, TX USA
STS-96 Mission Highlights, Part 3
Jul. 07, 1999; In English; Videotape: 41 min. 58 sec. playing time, in color, with sound
Report No.(s): JSC-1790/PT3; NONP-NASA-VT-1999087308; No Copyright; Avail: CASI; A02, Videotape-VHS; A22, Videotape-Beta

In this third part of a three-part video mission-highlights set, spacecrew operations between the STS-96 Space Shuttle Orbiter Discovery and the International Space Station, as well as STS reentry and landing is reviewed. The flight crew consists of Kent V. Rominger, Commander; Rick D. Husband, Pilot; and Mission Specialists Ellen Ochoa, Tamara E. Jernigan, Daniel T. Barry, Julie Payette (Canadian), and Valery Ivanovich Tokarev (Russian). The primary goals of this mission were to work on logistics and resupply the International Space Station. This third part of the three part series includes footage from Flight Days 8-11 (FD 8-11) of the mission. FD 8 includes the crew members moving the last items from Discovery into the International Space Station (ISS), closing the final hatch on the orbiting outpost and commanding a series of 17 pulses of Discovery's reaction control system jets to boost the station's orbit. Discovery undocks from the station, performs a 2 1/2 lap flyaround of the station, before Husband

fires Discovery's jets in a final burst to move Discovery away from the station, concluding six days of docked operations. After the flyaround, Husband fires Discovery's jets to depart the station's vicinity. Beginning FD 9, as Discovery departs from the station, Mission Specialists Tammy Jernigan and Dan Barry pack away the space suit gear they used during their spacewalk early in the mission, while Commander Kent Rominger and Pilot Rick Husband practice landings on a laptop computer program. Mission Specialists Julie Payette and Valery Tokarev help to stow gear and repressurize the shuttle's cabin to its standard 14.7 pounds per square inch. The crew also readies to deploy a small, student-built payload called STARSHINE (Student Tracked Atmospheric Research Satellite for Heuristic International Networking Equipment). In and around landing preparations and the STARSHINE deploy, the crew stowe all equipment used throughout the mission. The STARSHINE satellite ejects from a canister in Discovery's payload bay on FD 10. FD 11 is completed as Discovery swoops out of the darkness as Commander Kent Rominger sets the shuttle and his crewmates down on Runway 15 at the Shuttle Landing Facility in Florida to successfully complete the first shuttle mission of the year. Several different views of the landing are highlighted in the video.
CASI
Discovery (Orbiter); Space Shuttle Missions; International Space Station; Spacecrews; Spacecraft Landing; Spacecraft Reentry

18
SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see 54 Man/System Technology and Life Support. For related information see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation.

19990053805 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
An Improved Asynchronous Implementation of a Fast Fourier Transform Architecture for Space Applications
Barnhart, David J.; Mar. 1999; 123p; In English
Report No.(s): AD-A361780; AFIT/GE/ENG/99M-01; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A second-generation fully asynchronous Fast Fourier Transform (FFT) processor for space applications is developed in this thesis. A high-performance patented FFT architecture invented by Suter and Stevens was used as the basis for a 16-point FFT (FFT-16) processor design. A brief derivation of the architecture, the asynchronous design methodologies used and space-based integrated circuit issues are presented. The Synopsys VLSI CAD system and a radiation tolerant design library developed by the Air Force Research Laboratory were used to implement the design. A critical building block of the FFT-16, the FFT-4, was fabricated as a cost-effective method to validate the cell library and the applied asynchronous design methodologies before larger point sizes are fabricated. Results from high-fidelity simulations show that the FFT-16 design has an efficiency of 28 nJ/Unit-Transform and has a worst case throughput of 760 ns. Extrapolating these results to an FFT-1024 gives an estimated efficiency of 120 nj/Unit-Transform and worst case throughput of 2 microns. These results demonstrate that current space-based FFT processors can be replaced with a design that improves performance and efficiency by two orders of magnitude.
DTIC
Fast Fourier Transformations; Very Large Scale Integration; Radiation Hardening

19990053855 ILC Dover, Frederica, DE USA
Deployment Control Mechanisms for Inflatable Space Structures
Cadogan, David P., ILC Dover, USA; Grahne, Mark S., ILC Dover, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 31-41; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

Increases in the number of satellites to be launched over the next several decades will emphasize the need for the reduction of space hardware mass, stowage volume, and cost. One approach to realizing these reductions is through the use of inflatable, deployable, space structures. Inflatable structures offer many benefits over conventional deployable structures because they are lower in mass and can be packaged into small volumes, which reduce launch vehicle size and cost. The performance benefit margin of inflatable structures increases as the size of the structure increases, thus making the technology more attractive for large-scale systems. Examples of satellite components that benefit from the utilization of inflatable structures includes solar arrays, communications antennas, radar antennas, thermal/light shields, solar sails, etc. ILC Dover has developed several technologies to facilitate the use of inflatable structures in the manufacture of deployable satellite components. One such technology is the mechanism used to control the deployment of the structure from its packed state to its deployed state. The mechanism used can take several forms depending on the application. These mechanisms control the rate of deployment of the structure, directionality of deployment, and the structural rigidity of the structure during deployment. This paper discusses several of the controlled deployment

mechanisms available for use with inflatable space structures. The state of development of these mechanisms and examples of their application will also be discussed.
Author
Inflatable Space Structures; Space Erectable Structures; Controllers; Mechanization; Mechanical Devices

19990053915 General Accounting Office, National Security and International Affairs Div., Washington, DC USA
SPACE STATION: Status of Russian Involvement and Cost Control Efforts
Apr. 29, 1999; 11p; In English; Testimony before the Subcommittee on Science, Technology, and Space, Committee on Commerce, Science, and Transportation, U.S. Senate.
Report No.(s): AD-A363386; GAO/T-NSIAD-99-117; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Because of Russia's continuing funding problems, NASA developed a multi-faceted contingency plan to mitigate the risk of further delay of the Service Module and the possibility that a reboost capability cannot be provided by the Russians. Payments to Russia for the completion of the Service Module have also been made. Although NASA has developed a strategy to deal with Russian nonperformance, it has not completed an overall contingency plan to address a broader range of potential problems.
DTIC
Budgets; Space Stations; Financial Management; Service Modules

19990054352 Naval War Coll., Newport, RI USA
Denying Access to Commercial Communications Satellites ***Final Report***
Washington, Tania M.; Feb. 05, 1999; 23p; In English
Report No.(s): AD-A363096; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The commercialization of space has considerably changed the playing field within satellite communications. No longer is space owned and used solely by nation states. Many satellites, particularly communications satellites, are privately owned and operated and are used by both the private and military sectors. Commercial systems such as Orion, Panamsat, Iridium and Globalstar will provide the U.S. military and its potential adversaries with a relatively inexpensive and highly effective means to increase the command, control and communications (C3) capabilities of their respective forces. Because of this dual use of commercial communication satellites, what was once just a commercial satellite has the potential to become a military target. The Joint Task Force (JTF) Commander may want to deny or impede an adversary's access to commercial satellite communications in order to disrupt his C3 capabilities. In this paper, I will examine the application of force against commercial communication satellites applying the implications of the diverse ownership of communication satellites and the current treaties and laws.
DTIC
Satellite Communication; Space Commercialization; Command and Control; Commercial Spacecraft; Communication Satellites

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SPACECRAFT INSTRUMENTATION

For related information see also 06 Aircraft Instrumentation and 35 Instrumentation and Photography.

19990053858 California Univ., Space Sciences Lab., Berkeley, CA USA
The Design and Development of a Motorized Vacuum Door for the Far Ultraviolet Spectroscopic Explorer
Kromer, Karl, California Univ., USA; Donakowski, William, California Univ., USA; Siegmund, Oswald H. W., California Univ., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 73-83; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Far Ultraviolet Spectroscopic Explorer (FUSE), slated for launch in early 1999, is an astronomical instrument providing ultraviolet spectroscopy in the 90 to 170 nm bandpass. The Space Sciences Laboratory (SSL) provided the image intensifying detectors for FUSE, under contract from Johns Hopkins University, and NASA/Goddard. These detectors only operate in a vacuum, and are damaged by exposure to contaminates and air. We designed and developed a motorized vacuum door to protect the detectors while the instrument is exposed to air. The door incorporates several innovative features, including linear motion for a low profile; straight-line compression of the sealing o-ring to preclude a rolling failure; a redundant actuator that may be tested and reset remotely; and adaptability to future programs with minor modifications. This paper outlines the door design, its features, and a few minor technical challenges.
Author
Doors; Mechanical Devices; Motors; Functional Design Specifications; Mechanization; Vacuum Apparatus; Mechanical Drives

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SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also 07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion, and 15 Launch Vehicles and Space Vehicles.

19990054057 Orbital Technologies Corp., Madison, WI USA

Initial Test Firing Results for Solid CO/GOX Cryogenic Hybrid Rocket Engine for Mars ISRU Propulsion Applications

Rice, Eric E., Orbital Technologies Corp., USA; St. Clair, Christopher P., Orbital Technologies Corp., USA; Chiaverini, Martin J., Orbital Technologies Corp., USA; Knuth, William H., Orbital Technologies Corp., USA; Gustafson, Robert J., Orbital Technologies Corp., USA; Gramer, Daniel J., Orbital Technologies Corp., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 399-402; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

ORBITEC is developing methods for producing, testing, and utilizing Mars-based ISRU fuel/oxidizer combinations to support low cost, planetary surface and flight propulsion and power systems. When humans explore Mars we will need to use in situ resources that are available, such as: energy (solar); gases or liquids for life support, ground transportation, and flight to and from other surface locations and Earth; and materials for shielding and building habitats and infrastructure. Probably the easiest use of Martian resources to reduce the cost of human exploration activities is the use of the carbon and oxygen readily available from the CO2 in the Mars atmosphere. ORBITEC has conducted preliminary R&D that will eventually allow us to reliably use these resources. ORBITEC is focusing on the innovative use of solid CO as a fuel. A new advanced cryogenic hybrid rocket propulsion system is suggested that will offer advantages over LCO/LOX propulsion, making it the best option for a Mars sample return vehicle and other flight vehicles. This technology could also greatly support logistics and base operations by providing a reliable and simple way to store solar or nuclear generated energy in the form of chemical energy that can be used for ground transportation (rovers/land vehicles) and planetary surface power generators. This paper describes the overall concept and the test results of the first ever solid carbon monoxide/oxygen rocket engine firing.

Author

Carbon Monoxide; Test Firing; Extraterrestrial Resources; Cryogenic Rocket Propellants; Chemical Propulsion; Propellant Combustion; Hybrid Propellants; Hybrid Propellant Rocket Engines

23
CHEMISTRY AND MATERIALS (GENERAL)

19990053546 University of Electro-Communications, Tokyo, Japan

Bulletin of the University of Electro-Communications, Volume 11

December 1998; ISSN 0915-0935; 108p; In Japanese; See also 19990053547 through 19990053551; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Contents include the following: Observations of grain and ferroelectric domain of hot-pressed Pb(1-x)La(x)(Zr(y)Ti(1-y)(1-x/4)O3 ceramics using a transmission electron microscope. Acoustic, optical and piezoelectric properties of Pb(1-x)La(x)(Xr(y)Ti(1-y)(1-x/4)O3 (PLZT) ceramics in relations to grain and ferroelectric domain structures. Development of an annual array ultrasonic transducer for clinical investigation. Preparation and characterization of nitrogen-doped diamond-like carbon (DLC) thin films.

CASI

Acoustic Properties; Carbon; Ceramics; Diamonds; Hot Pressing; Lead Zirconate Titanates

19990053806 Institute of Microbial Technology, Chandigarh, India

Molecular Basis of P-Nitrophenol (PNP) Biodegradation and its Application in the Environment ***Final Report, 30 Sep. 1997 - 29 Sep. 1998***

Jain, Rakesh K.; Mar. 04, 1999; 5p; In English

Contract(s)/Grant(s): F49620-97-I-0538

Report No.(s): AD-A361775; AOARD-97-01; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

By taking plasmid samples from the US and India, basic microbial science was related to field application. The distribution of plasmid ecology and gene sequences for a variety of isolates were studied towards an understanding of the genetics and distributions of microorganisms capable of utilizing PNP as their sole source of carbon, nitrogen, and energy. The studies indicate that 1) the degradation of PNP by several organisms proceeds through an oxidative route, as indicated by the accumulation of nitrite

molecules in his cultures, 2) the plasmid responsible for carrying the gene for PNP degradation in certain microbes consists of approximately 50 kilo base pairs, and 3) the same plasmid also encodes resistance to inorganic zinc ions. Genes were successfully cloned as a basis for further environmental application. As a means of natural attenuation, the development of bioremediation technologies could save millions in addressing contamination sites, with wide application to the remediation of contaminants in soil and groundwater everywhere.
DTIC
Biodegradation; Microorganisms; Contaminants; Contamination; Transistors

19990053911 Department of the Navy, Washington, DC USA
Nonlinear Optical Inclusion Complexes
Kim, Oh-Kil, Inventor; Choi, Ling-Siu, Inventor; Zhang, Heyi, Inventor; He, Xue H., Inventor; Shih, Yan H., Inventor; Jun. 09, 1998; 9p; In English; Supersedes US-Patent-Appl-SN-490413, AD-D017664.
Patent Info.: Filed 14 Jun. 95,; US-Patent-Appl-SN-490,413; US-Patent-5,763,066
Report No.(s): AD-D019306; No Copyright; Avail: US Patent and Trademark Office, Microfiche

Inclusion complexes have an organic guest molecule dye with an electron donor portion, an electron acceptor portion and a hydrophobic tail portion disposed within an organic carbohydrate host molecule. The dye in the inclusion complexes has improved thermal stability compared to itself. The complexes can be used to form a solution-cast film disposed on a substrate wherein the film thickness is up to about 20 microns and the film is made of anisotropically self-aligned (self-poled) inclusion complexes.
DTIC
Thermal Stability; Nonlinearity; Nonlinear Optics

19990054154 Brigham Young Univ., Dept.of Chemistry and Biochemistry, Provo, UT USA
Syntheses and Crystal Structures of Novel Diaza-18-Crown-6 Ligands Containing Aromatic Thiol-Derived Side Arms
Su, Ning, Brigham Young Univ., USA; Bradshaw, Jerald S., Brigham Young Univ., USA; Xue, Guoping, Brigham Young Univ., USA; Dalley, N. K., Brigham Young Univ., USA; Savage, Paul B., Brigham Young Univ., USA; May 07, 1999; 13p; In English
Contract(s)/Grant(s): N00014-98-1-0485
Report No.(s): AD-A362936; TR-9; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Mannich aminomethylation reaction of aromatic thiols has been used to produce diaza-18-crown-6 ligands containing thiol-derived side arms. Thiophenols were attached to the azacrown through N-CH2-S linkages even in the presence of hydroxy or acetamido groups. Heteroaromatic thiols containing N=C-SH (or NH-C=S) structural fragments were attached to diaza-18-crown-6 by N-CH2-N linkages with the thiol becoming a thione function. X-ray crystal structures provide proof of the N-CH2-S and N-CH2-N linkages for the products of reactions with thiophenols and heteroaromatic thiols, respectively.
DTIC
Crystal Structure; Crystallinity; Chemical Bonds; Ligands; Thiols; Ethers

19990054483 Nagoya Univ., Dept. of Crystalline Materials Science, Furo, Japan
Present results at KEK and future expectations in the study of liquids and amorphous materials
Fukunaga, T., Nagoya Univ., Japan; Kameda, Y., Yamagata Univ., Japan; Misawa, M., Niigata Univ., Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 81-86; In English; See also 19990054467; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The static structure of many liquids and amorphous materials has been studied by using the high intensity total scattering spectrometer. So far excellent data have been obtained every year. Recently the structural change due to the metal insulator transition in SiV amorphous alloys was clarified through the coordination numbers of V-Si and Si-Si pair correlations. The short range structure of silica aerogels was also elucidated in comparison with that of common SiO2 glass (fused silica). The structure of liquid and gaseous CCl4 from 195 C to the subcritical point 275 C along the liquid-vapor coexistence curve has been studied to get an insight into the long range density fluctuation and atomic scale arrangement. The isotope substitution method applied to study a solvation structure of Li(+) ion in methanolic solutions.
Author
Amorphous Materials; Liquids; Scattering; Solvation; Neutron Scattering; Liquid-Vapor Interfaces

24
COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see 27 Nonmetallic Materials.

19990053802 Minerals, Metals and Materials Society, Warrendale, PA USA
The Third Pacific Rim International Conference on Advanced Materials and Processing, Volumes 1 and 2 ***Final Report***
Scott, Alexander; Jul. 1998; 1654p; In English; 3rd, 12-16 Jul. 1998, Honolulu, HI, USA
Contract(s)/Grant(s): DAAG55-98-1-0327
Report No.(s): AD-A359424; ARO-38732.1-MS-CF-Vol-1-2; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

Topics discussed include: Microstructural Analysis of Vanadium Bearing High Manganese Precipitation Hardening Stainless Steel; Ti-B2 - Particle - Reinforced High Modulus Steel; Structure and Mechanical Properties of Ultra Low Carbon/Ti Added Steels; Interaction Between Melts and Refractory in Process of Smelting Reduction with Iron Bath; The Effect of the Titanium Traces on the Mechanical Properties of an Ultra High Strength Steel; Microalloying of Steel 16 Mn With Niobium; Microstructure and Mechanical Properties of SUS 316L Stainless Steel Manufactured by High Strain PM Process; The Effects of Microstructure and Prestrain on Fatigue Strength of Dual-Phase Steels; Structure Control of Metastable Austenitic Stainless Steels through Deformation Induced Transformation and Aging Treatment; Local Mechanical Properties of Steel Weldments; On the Mechanism of Decreasing the Slab Reheating Temperature of Hi-B Steels by the Addition of Molybdenum; A New Material for the Contact Cable Part I: Feasibility Study.
DTIC
Composite Materials; Alloys; High Strength Steels; Stainless Steels; Refractory Materials; Structural Analysis; Refractory Metals; Manufacturing

19990054600 Oak Ridge National Lab., Metals and Ceramics Div., TN USA
Iron and Nickel Aluminide Composites
Schneibel, Joachim H., Oak Ridge National Lab., USA; Becher, Paul F., Oak Ridge National Lab., USA; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 1-12; In English
Contract(s)/Grant(s): DE-AC05-96OR-22464; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Iron and nickel aluminide intermetallics are not only oxidation and corrosion resistant, but also thermodynamically compatible with a wide range of ceramics. This makes them suitable as the matrix for a wide range of composite systems. Among the composites evaluated to date are combinations of FeAl or Ni3Al with WC, TiC, SiC, TiB2, and Al2O3, with ceramic volume fractions ranging from 5 to 90%. A variety of processing techniques has been employed, but conventional liquid phase sintering and pressureless melt infiltration appear to be the most successful ones. Recently, a novel one-step melt infiltration procedure has been developed to fabricate composites with ceramic volume fractions approaching 90%. Room temperature flexure strengths as high as 1.8 GPa have been obtained. Both FeAl and Ni3Al composites exhibit fracture toughnesses similar to those of WC/Co. It is found that sufficiently thin (is less than 2 micrometers) ligaments of FeAl tend to fracture in a ductile manner. The absence of cleavage fracture in these thin ligaments is due to the unavailability of sufficiently long dislocation pile-ups for nucleating cleavage cracks. In addition to the mechanical properties of FeAl and Ni3Al composites, other properties of interest such as wear and corrosion resistance are briefly discussed. The properties of FeAl and Ni3Al composites are seen to complement each other and may be of interest in those applications where WC/Co composites have limitations.
Author
Iron; Iron Alloys; Nickel Alloys; Nickel Aluminides; Aluminum Alloys

19990054626 Oak Ridge National Lab., TN USA
Tensile and compressive behavior of a swirl mat composite
Ruggles, M. B.; Jul. 31, 1998; 52p; In English
Report No.(s): DE98-058131; ORNL/TM-13519; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Durability of Lightweight Composite Structures Project was established at Oak Ridge National Laboratory (ORNL) by the US Department of Energy to provide the experimentally-based, durability-driven design guidelines necessary to assure long-term structural integrity of automotive composite components. The initial focus of the ORNL Durability Project was on one representative reference material--an isocyanurate (polyurethane) reinforced with continuous strand, swirl-mat E-glass. This report

describes tensile and compressive testing and results for the reference composite. Behavior trends and proportional limit are established for both tension and compression. Damage development due to tensile loading and strain rate effects are discussed.
NTIS
Composite Materials; Tensile Properties; Compressibility; Durability; Polyurethane Resins

25
INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also 77 Thermodynamics and Statistical Physics.

19990052837 NASA Glenn Research Center, Cleveland, OH USA
A Precise Calibration Technique for Measuring High Gas Temperatures
Gokoglu, Suleyman A., NASA Glenn Research Center, USA; Schultz, Donald F., NASA Glenn Research Center, USA; June 1999; 16p; In English; Mediterranean Combustion, 20-25 Jun. 1999, Antalya, Turkey; Sponsored by Combustion Inst., USA
Contract(s)/Grant(s): RTOP 963-15-0G
Report No.(s): NASA/TM-1999-209280; E-11745; NAS 1.15:209280; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A technique was developed for direct measurement of gas temperatures in the range of 2050 K - 2700 K with improved accuracy and reproducibility. The technique utilized the low-emittance of certain fibrous Materials, and the uncertainty of the technique was limited by the uncertainty in the melting points of the materials, i.e., +/- 15 K. The materials were pure, thin, metal-oxide fibers whose diameters varied from 60 mm to 400 mm in the experiments. The sharp increase in the emittance of the fibers upon melting was utilized as indication of reaching a known gas temperature. The accuracy of the technique was confirmed by both calculated low emittance values of transparent fibers, of order 0.01, up to a few degrees below their melting point and by the fiber-diameter independence of the results. This melting-point temperature was approached by increments not larger than 4 K, which was accomplished by controlled increases of reactant flow rates in hydrogen-air and/or hydrogen- oxygen flames. As examples of the applications of the technique, the gas-temperature measurements were used (a) for assessing the uncertainty in infering gas temperatures from thermocouple measurements, and (b) for calibrating an IR camera to measure gas temperatures. The technique offers an excellent calibration reference for other gas-temperature measurement methods to improve their accuracy and reliably extending their temperature range of applicability.
Author
Calibrating; Procedures; Temperature Measurement; High Temperature Gases; Gas Temperature

19990053576 Auburn Univ., Dept. of Electrical Engineering, AL USA
Electron Assisted Deposition of Cubic Boron Nitride by RF Magnetron Sputtering ***Final Report, 1 May 1998 - 30 Apr. 1999***
Tzeng, Yonhua, Auburn Univ., USA; Zhu, Hongbin, Auburn Univ., USA; Apr. 30, 1999; 16p; In English
Contract(s)/Grant(s): N00014-98-1-0571
Report No.(s): AD-A362770; TR-3; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Cubic boron nitride (cBN) is deposited on silicon by means of radio-frequency (RF) magnetron sputtering in nitrogen using a hexagonal boron nitride target with the assistance of a simultaneous electron bombardment of the growing surface. Unlike most thin-film deposition processes for cBN, intentional bombardment of the growing surface by ion beams within specific ranges in energy and flux is not required for this process to achieve high purity cBN films. With electrons bombarding the growing surface at a current density of 140 mA/sq cm or higher, pure (according to FTIR spectra) cBN films are deposited on silicon substrates at temperatures above 750 deg C. Effects of electron current density and nitrogen gas pressure on the synthesis of cBN films will be discussed.
DTIC
Boron Nitrides; Magnetron Sputtering; Thin Films; Deposition

19990053663 Federal Aviation Administration, Fire Safety Research and Development, Atlantic City, NJ USA
Activation of Oxygen Generators in Proximity to Combustible Materials
O'Connor, T. R.; Hagen, E. L.; May 1999; 26p; In English
Report No.(s): PB99-147324; DOT/FAA/AR-TN99/9; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents the results of a series of tests performed on oxygen generators contained in cardboard shipping containers and packing materials to witness the probability of ignition in the event one of the generators was activated. Test results indicated that in the presence of an activated generator, combustible materials will produce a fire.
NTIS
Oxygen; Activation; Generators; Proximity

19990053695 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
Background Fluorescence in an Aerosol Biodetector Based on 266-nm Excitation
Aggarwal, Roshan L.; May 17, 1999; 22p; In English
Contract(s)/Grant(s): F19628-95-C-0002
Report No.(s): AD-A363355; TR-1052; ESC-TR-98-045; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Background fluorescence in an aerosol biodetector based on 266-nm excitation has been investigated, using a gas cell which could be evacuated and then filled with a gas (of interest) at a known pressure. A frequency-quadrupled, Q-switched Nd:YAG microchip laser with a pulse width of less than I ns and a pulse repetition rate of 10(exp 4) pps was used to measure both fluorescence and Rayleigh scattering in a direction at 900 to the 266-nm excitation beam, as a function of the gas pressure for nitrogen, oxygen, and room air. Rayleigh scattering was also measured for helium and xenon gases. The relative Rayleigh scattering cross sections measured in this work are consistent with their previously reported values, ensuring that the observed fluorescence was originating from a region of the gas in the direct path of the 266-nm excitation beam. Fluorescence signal observed in the spectral range of interest 300-650 nm under nominal vacuum conditions (1 x 10(exp -5) torr) exhibited strong quenching upon filling the gas cell with oxygen, but not with nitrogen. Strong oxygen-induced quenching leads us to believe that the background fluorescence is due, at least in part, to the presence of residual hydrocarbons in the atmospheric air.
DTIC
Fluorescence; Neodymium Lasers; Bioinstrumentation; Aerosols

19990053701 Brigham Young Univ., Dept. of Chemistry and Biochemistry, Provo, UT USA
Preliminary Complexation Studies of Bis-(8-Hydroxyquinoline)-substituted Tetraaza-15-crown-5 with Various Metal Ions
Zhang, Xian X.; Bradshaw, Jerald S.; Bronson, R. T.; Savage, Paul B.; Izatt, Reed M.; Apr. 06, 1999; 9p; In English
Contract(s)/Grant(s): N00014-98-1-0485
Report No.(s): AD-A361705; TR-7; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Complexation of bis(8-hydroxyquinoline)-substituted tetraaza-15-crown-5 with Cu(2+), Co(2+), Ni(2+), Zn(2+), Cd(2+), and Pb(2+) was evaluated potentiometrically in aqueous solution (0.10 M Me4NCl) at 25 C. Ligand 1 formed very stable complexes with these metal ions. The UV-Vis spectra of ligand 1 and its complexes were examined in an aqueous acetic acid buffer solution (pH 4.7). The 1-Cu(2+) complex provided a new absorption band at 258 nm.
DTIC
Synthesis (Chemistry); Metal Ions; Heterocyclic Compounds; Quinones; Ligands; Aqueous Solutions; Potentiometric Analysis

19990053729 Naval Postgraduate School, Monterey, CA USA
Analytical Transmission Electron Microscopy Studies on Copper-Alumina Interfaces
Hashimoto, Richard Y.; Jun. 1999; 100p; In English
Report No.(s): AD-A362728; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche
A diffusion bonded copper-alumina interface had been studied using energy dispersive x-ray spectroscopy (EDX) and electron energy loss spectroscopy (EELS). Investigations of polycrystalline alumina showed that silica, a common commercial impurity, was present at the triple junctions in the form of fine mullite crystals in a glassy, silicon rich phase. Silicon was also detected along the alumina grain boundaries near triple junctions. There was no observed diffusion of Cu into alumina or alumina into copper. TEM results indicated no interface phase in the these vacuum formed samples. EDX studies of the interfaces revealed that silicon was present in varying concentrations from 1.O at.% to 10.0 at.%. Using spatial difference, PEELS at the interface showed two distinct residuals: a coordination similar to an aluminosilicate for silicon rich areas and a coordination similar to a metal to metal coordination for low silicon regions. Comparison of the Si rich interface residual PEELS spectra to that of the alumina triple junction PEELS spectra showed that the interface had atomic environments similar to that of as aluminosilicate, such as mullite. The interface results suggest that Si segregation may contribute to the observed higher strength of the metal-ceramic composite by void filling and modified bond character.
DTIC
Electron Microscopy; Aluminum Oxides; Copper; Diffusion Welding; Energy Dissipation; Transmission Electron Microscopy;

19990053906 Office National d'Etudes et de Recherches Aeronautiques, Paris, France

Study and Development of the PEUL Turbulent Combustion Model. Application to Prediction of Soot Formation in Gas Turbine Combustor ***Etude et developpement du modele de combustion turbulente PEUL. Application a la prediction de la formation des suies dans les foyers aeronautiques***

Varin, Etienne, Office National d'Etudes et de Recherches Aeronautiques, France; 1999; ISSN 0078-3780; 146p; In French; Original contains color illustrations

Report No.(s): ONERA-NT-1992-2; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This work deals with the numerical simulation of turbulent reactive flows. The aim of the study is to develop a model able to predict soot formation in aeronautical combustion chambers. We use a Probabilistic EUlerian Lagrangian (PEUL) method to describe the turbulent combustion. With this model, the velocity field is calculated by solving Navier-Stokes equations. Chemical composition and temperature fields are obtained by solving the Probability Density Function transport equation with a Monte Carlo method. A soot model is coupled to the combustion model in order to compute soot levels. The different processes of soot formation and destruction are taken into account : precursors formation , nucleation, surface growth, coagulation and oxidation of soot particles. We compare computation results with experimental results in the case of an ethylene/air turbulent diffusion flame. Finally, an application of our model to a practical case is related. The three dimensional numerical simulation of an aeronautical combustion chamber is presented.

Author

Research; Fabrication; Turbulent Flow; Combustion Chambers; Soot; Numerical Analysis; Turbulent Combustion; Three Dimensional Models; Diffusion Flames

19990053979 Michigan Univ., Ann Arbor, MI USA

Soot Formation in Laminar Premixed Flames

Xu, F., Michigan Univ., USA; Krishnan, S. S., Michigan Univ., USA; Faeth, G. M., Michigan Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 61-64; In English; See also 19990053965

Contract(s)/Grant(s): NAG3-1878; NAG3-2048; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Soot processes within hydrocarbon-fueled flames affect emissions of pollutant soot, thermal loads on combustors, hazards of unwanted fires and capabilities for computational combustion. In view of these observations, the present study is considering processes of soot formation in both burner-stabilized and freely-propagating laminar premixed flames. These flames are being studied in order to simplify the interpretation of measurements and to enhance computational tractability compared to the diffusion flame environments of greatest interest for soot processes. In addition, earlier studies of soot formation in laminar premixed flames used approximations of soot optical and structure properties that have not been effective during recent evaluations, as well as questionable estimates of flow residence times). The objective of present work was to exploit methods of avoiding these difficulties developed for laminar diffusion flames to study soot growth in laminar premixed flames. The following description of these studies is brief.

Derived from text

Premixed Flames; Laminar Flow; Soot; Hydrocarbon Combustion; Buoyancy

19990053982 Princeton Univ., Dept. of Mechanical and Aerospace Engineering, NJ USA

Structure and Transient Response of Spherical Flames

Law, C. K., Princeton Univ., USA; Tse, S. D., Princeton Univ., USA; He, L., Princeton Univ., USA; Zhu, D. L., Princeton Univ., USA; Sung, C. J., Princeton Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 73-76; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The present research endeavor is concerned with gaining fundamental understanding of the configuration, structure, and dynamics of laminar flames in simple, well-defined flow fields such that the phenomena of interest can be studied without being unduly complicated and compromised by complex and sometimes non-quantifiable flow field effects. Consequently, microgravity, one-dimensional, spherically-symmetric flames are expected to yield data of high fidelity, which can be meaningfully interpreted as well as compared with numerical calculations for the understanding of the basic flame structure in general and flame chemistry and dynamics in particular. Moreover, such one-dimensional flames are readily amenable to theoretical study, through which the underlying physics of specific transient responses and their corresponding flame structures can be extracted. We have recently extended our studies of the structures and transient responses of spherical flames along the following directions: (1) theoretical study of the role of flamefront motion in droplet burning to determine the range of validity of the classical quasi-steady theory in predicting the flame standoff ratio, as well as its implication on transient fuel vapor accumulation/depletion; (2)

experimental and computational investigation of the influences of the gas-phase transient processes of fuel vapor accumulation and far-field diffusion on the flamefront movement and the attainment of steady state for burner-generated spherical diffusion flames, without the additional transient process of droplet surface regression; and (3) theoretical and numerical study of the dynamics involved in the transition from a propagating spherical flame to a stationary flame ball.
Derived from text
Flames; Spheres; Flame Propagation; Transient Response; Drops (Liquids); Vapors; Fuel Combustion; Diffusion Flames

19990053983 NASA Glenn Research Center, Cleveland, OH USA
Planar Strain-Rate-Free Diffusion Flames: Initiation, Properties, and Extinction
Fendell, Francis, TRW Space Technology Labs., USA; Gokoglu, Suleyman, NASA Glenn Research Center, USA; Rungaldier, Harald, TRW Space Technology Labs., USA; Schultz, Donald, Schultz Engineering Services, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 77-80; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

An effectively strain-rate-free diffusion flame constitutes the most vigorous laminar combustion of initially unmixed reactive gases. Such a diffusion flame is characterized by a relatively long residence time and by a relatively large characteristic length scale. If such a flame were also planar, providing high symmetry, it would be particularly suitable for experimental and theoretical investigations of key combustion phenomena, such as multicomponent diffusion, chemical kinetics, and soot inception, growth, and oxidation. Unfortunately, a planar strain-rate-free diffusion flame is highly disrupted in earth-gravity (e.g., in a counterflow-diffusion-flame apparatus) because of the very rapid onset (approx. 100 ms) of gravity-induced instability. Accordingly, a specially dedicated apparatus was designed, fabricated, and initially checked out for the examination of a planar strain-rate-free diffusion flame in microgravity. Such a diffusion flame may be formed within a hollowed-out squat container (initially configured as 25 cm x 25 cm x 9 cm), with isothermal, noncatalytic, impervious walls. At test initiation, a thin metallic sheet (approx. 1 mm in thickness) that separates the internal volume into two equal portions, each of dimensions 25 cm x 25 cm x 4.5 cm, is withdrawn, by uniform translation (approx. 50 cm/s) in its own plane, through a tightly fitting slit in one side wall. Thereupon, diluted fuel vapor (initially confined to one half-volume of the container) gains access to diluted oxygen (initially with the same pressure, density, and temperature as the fuel, but initially confined to the other half-volume). After a brief delay (approx. 10 ms), to permit limited but sufficient-for-flammability diffusional interpenetration of fuel vapor and oxidizer, burning is initiated by discharge of a line igniter, located along that side wall from which the trailing edge of the separator withdraws. The ignition spawns a triple-flame propagation across the 25 cm x 25 cm centerplane. When a diffusion flame is emplaced in the centerplane, any subsequent travel, and change in temperature, of that planar diffusion flame may be tracked, along with the effectively spatially uniform but temporally evolving pressure within the container. Eventually, nearly complete depletion of the stoichiometrically deficient reactant, along with heat loss to the container surfaces, effects extinction. These data afford an opportunity to check theoretical models of diffusion and chemical kinetics under conditions ranging from intense burning to flame out, or, alternatively, to evolve simple empirical representations of these phenomena. Thus, the project sought to utilize microgravity testing to elucidate commonly encountered phenomenology, arising in the commonly-encountered mode of combustion (whether related to heating, manufacturing, boiling, and propulsion, or to uncontrolled, free-burning fire in structures and wildland vegetation), of those commonly utilized fuels usually categorized as gaseous fuels (such as hydrogen, natural gas, and propane, which are gaseous under atmospheric conditions).
Derived from text
Diffusion Flames; Strain Rate; Gravitational Effects; Reaction Kinetics; Microgravity; Flame Propagation; Combustion Physics; Flameout; Initiation; Extinction; Fuel Combustion; Ignition

19990053985 Northwestern Univ., Dept. of Mechanical Engineering, Evanston, IL USA
Hydrodynamics of Spherical Flows and Geometry of Premixed Flames near the Stagnation Point of Axisymmetric Viscous Counterflows
Sohrab, Siavash H., Northwestern Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 85-88; In English; See also 19990053965
Contract(s)/Grant(s): NAG3-1863; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Counterflow premixed flames play a significant role in the modeling of laminar flames. This is in part motivated by the fact that stretched premixed flames simulate local flamelet dynamics within turbulent premixed flames. In the present study, the modified form of the Navier-Stokes equation for reactive fields introduced earlier is employed to investigate the hydrodynamics of

spherical flows embedded within counterflows. The geometry of premixed flames near the stagnation point is also determined. The predictions are in favorable agreement with the experimental observations and prior numerical studies.
Author
Premixed Flames; Hydrodynamics; Radial Flow; Turbulent Flames; Viscous Flow; Navier-Stokes Equation; Counterflow; Mathematical Models; Computerized Simulation

19990053986 Maryland Univ., Dept. of Fire Protection Engineering, College Park, MD USA
Experimental Observations on a Low Strain Counter-Flow Diffusion Flame: Flow and Bouyancy Effects
Sutula, J. A., Maryland Univ., USA; Torero, J. L., Maryland Univ., USA; Ezekoye, O. A., Texas Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 89-92; In English; See also 19990053965
Contract(s)/Grant(s): NAG3-1960; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Diffusion flames are of great interest in fire safety and many industrial processes. The counter-flow configuration provides a constant strain flow, and therefore is ideal to study the structure of diffusion flames. Most studies have concentrated on the high velocity, high strain limit, since buoyantly induced instabilities will disintegrate the planar flame as the velocity decreases. Only recently, experimental studies in microgravity conditions have begun to explore the low strain regimes. Numerical work has shown the coupling between gas phase reaction rates, soot reaction rates, and radiation. For these programs, size, geometry and experimental conditions have been chosen to keep the flame unaffected by the physical boundaries. When the physical boundaries can not be considered infinitely far from the reaction zone discrepancies arise. A computational study that includes boundary effects and accounts for the deviations occurring when the major potential flow assumptions are relaxed was presented by Borlik et al. This development properly incorporates all heat loss terms and shows the possibility of extinction in the low strain regime. A major constraint of studying the low strain regime is buoyancy. Buoyant instabilities have been shown to have a significant effect on the nature of reactants and heat transport, and can introduce instabilities on the flow that result in phenomena such as flickering or fingering. The counter-flow configuration has been shown to provide a flame with no symmetry disrupting instabilities for inlet velocities greater than 50 mm/s. As the velocity approaches this limit, the characteristic length of the experiment has to be reduced to a few millimetres so as to keep the Rayleigh number (Ra(sub L) = (Beta)(g(sub 0))(L(exp 3) del T)/(alpha(v))) below 2000. In this work, a rectangular counter-flow burner was used to study a two-dimensional counter-flow diffusion flame. Flow visualisation and Particle Image Velocimetry served to describe the nature of the stagnation plane for strain rates smaller than 100 (1/s). These experiments were conducted with a non-reacting flow. Video images of a propane air diffusion flame were used to describe the behaviour of a diffusion flame in this regime. Flame geometry and pulsation frequency are described.
Author
Diffusion Flames; Counterflow; Buoyancy; Flow Visualization; Reacting Flow; Strain Rate; Two Dimensional Flow

19990053988 NASA Glenn Research Center, Cleveland, OH USA
Influence of Buoyant Convection on the Stability of Enclosed Laminar Flames
Brooker, John E., NASA Glenn Research Center, USA; Jia, Kezhong, Iowa Univ., USA; Stocker, Dennis P., NASA Glenn Research Center, USA; Chen. Lea-Der, Iowa Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 97-100; In English; See also 19990053965
Contract(s)/Grant(s): NAG3-1592; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Enclosed diffusion flames are commonly found in practical combustion systems, such as the power-plant combustor, gas turbine combustor, and jet engine after-burner. In these systems, fuel is injected into a duct with a co-flowing or cross-flowing air stream. In combustors, this flame is anchored at the burner (i.e., fuel jet inlet) unless adverse conditions cause the flame to lift off or blow out. Investigations of burner stability study the lift off, reattachment, and blow out of the flame. There have been numerous studies of flame stability. Relatively few studies have investigated the stability of flames with an oxidizer co-flow, compared with the number of studies on (nearly) free jet diffusion flames. The air flow around the fuel jet can significantly alter the lift off, reattachment and blow out of the jet diffusion flame. In normal gravity, however, the effects of the air flow on flame stability are often complicated by the presence of buoyant convection. A comparison of normal-gravity and microgravity flames can provide clear indication of the influence of forced and buoyant flows on the flame stability. The overall goal of the Enclosed Laminar Flames (ELF) research, described at the following URL site: http://zeta.lerc.nasa.gov/expr/elf.htm, is to improve our understanding of the effects of buoyant convection on the structure and stability of co-flow diffusion flames.
Derived from text
Diffusion Flames; Flow Stability; Microgravity; Spaceborne Experiments; Gravitational Effects; Flame Stability; Buoyancy; Convective Flow; Fuel Flow; Burnout; Fuel Combustion

19990053990 Yale Univ., Dept. of Mechanical Engineering, New Haven, CT USA

The Effects of Buoyancy and Dilution on the Structure and Lift-off of Coflow Laminar Diffusion Flames

Walsh, Kevin T., Yale Univ., USA; Long, Marshall B., Yale Univ., USA; Smooke, Mitchell D., Yale Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 105-108; In English; See also 19990053965

Contract(s)/Grant(s): NAG3-1939; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The ability to predict the coupled effects of complex transport phenomena with detailed chemical kinetics in diffusion flames is critical in the modeling of turbulent reacting flows and in understanding the processes by which soot formation and radiative transfer take place. In addition, an understanding of the factors that affect flame extinction in diffusion flames is critical in the suppression of fires and in improving engine efficiency. The goal of our characterizations of coflow laminar diffusion flames is to bring to microgravity the multidimensional diagnostic tools available in normal gravity, and in so doing provide a broader understanding of the successes and limitations of current combustion models. This will lead to a more detailed understanding of the interaction of convection, diffusion and chemistry in both buoyant and nonbuoyant environments. As a sensitive marker of changes in the flame shape, the number densities of excited-state CH (A(exp 2)delta, denoted CH*), and excited-state OH (A(exp 2)Sigma, denoted OH*) are measured in mu-g and normal gravity. Two-dimensional CH* and OH* number densities are deconvoluted from line-of-sight chemiluminescence measurements made on the NASA KC-135 reduced-gravity aircraft. Measured signal levels are calibrated, post-flight, with Rayleigh scattering. Although CH* and OH* kinetics are not well understood, the CH*, OH*, and ground-state CH distributions are spatially coincident in the flame anchoring region. Therefore, the ground-state CH distribution, which is easily computed, and the readily measured CH*/OH* distributions can be used to provide a consistent and convenient way of measuring lift-off height and flame shape in the diffusion flame under investigation. Given that the fuel composition affects flame chemistry and that buoyancy influences the velocity profile of the flow, we have the opportunity to computationally and experimentally study the roles of fluids and chemistry. In performing this microgravity study, improvements to the computational model have been made and new calculations performed for a range of gravity and flow conditions. Furthermore, modifications to the experimental approach were required as a consequence of the constraints imposed by existing microgravity facilities. Results from the computations and experiments are presented in the following sections.

Author

Buoyancy; Dilution; Diffusion Flames; Laminar Flow; Microgravity; Reacting Flow; Transport Properties; Fuel Combustion; Combustion Physics; Computerized Simulation; Mathematical Models; Gravitational Effects

19990053991 NASA Glenn Research Center, Cleveland, OH USA

Effects of Buoyancy in Hydrogen Jet Diffusion Flames

Agrawal, A. K., Oklahoma Univ., USA; Al-Ammar, K., Oklahoma Univ., USA; Gollahalli, S. R., Oklahoma Univ., USA; Griffin, D. W., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 109-112; In English; See also 19990053965

Contract(s)/Grant(s): NAG3-1594; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This project was carried out to understand the effects of heat release and buoyancy on the flame structure of diffusion flames. Experiments were conducted at atmospheric pressure in both normal gravity and microgravity conditions in the NASA LeRC 2.2 s drop tower. Experiments were also conducted in a variable pressure combustion facility in normal gravity to scale buoyancy and thus, to supplement the drop tower experiments. Pure H2 or H2 mixed with He was used as the jet fluid to avoid the complexities associated with soot formation. Fuel jet burning in quiescent air was visualized and quantified by the Rainbow Schlieren Deflectometry (RSD) to obtain scalar profiles (temperature, oxygen concentration) within the flame. Burner tube diameter (d) was varied from 0.3 to 1.19 mm producing jet exit Reynolds numbers ranging from 40 to 1900, and generating flames encompassing laminar and transitional (laminar to turbulent) flow structure. Some experiments were also complemented with the CFD analysis. In a previous paper, we have presented details of the RSD technique, comparison of computed and measured scalar distributions, and effects of buoyancy on laminar and transitional H2 gas-jet diffusion flames. Results obtained from the RSD technique, variable pressure combustion chamber, and theoretical models have been published. Subsequently, we have developed a new drop rig with improved optical and image acquisition. In this set up, the schlieren images are acquired in real time and stored digitally in RAM of an onboard computer. This paper deals with laminar diffusion flames of pure H2 in normal and microgravity.

Author

Diffusion Flames; Jet Flow; Drop Towers; Microgravity; Gravitational Effects; Heat Transfer; Transition Flow; Turbulent Flow; Laminar Flow; Buoyancy; Fuel Combustion

19990053995 Centre National de la Recherche Scientifique, Lab. de Combustion et Systemes Reactifs, Orleans, France

Preliminary Analysis of High Pressure Spray and Cloud Combustion Module for the ISS

Goekalp, I., Centre National de la Recherche Scientifique, France; Chauveau, C., Centre National de la Recherche Scientifique,

France; Durox, D., Ecole Centrale de Paris, France; Lacas, F., Ecole Centrale de Paris, France; Legrand, B., Centre National de la Recherche Scientifique, France; Shafirovich, E., Centre National de la Recherche Scientifique, France; Fifth International Microgravity Combustion Workshop; May 1999, pp. 127-130; In English; See also 19990053965; Sponsored in part by the NATO Research Fellowship Program; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Combustion of droplet sprays and particle clouds is a very important area due to numerous applications to engines and power systems as well as to problems of industrial safety and clean environment. However, combustion of two-phase systems is not well understood yet. The detailed characterization of single droplet and particle burning necessitates the determination of temperature and chemical species concentration fields. Such measurements necessitate spatial and temporal resolutions that are impossible to attain with small particles. Therefore, one is obliged to move to larger droplet or particle sizes, and this brings in natural convection effects, which are proportional to the third power of the system characteristic dimension. In addition, natural convection effects are strongly increased under high pressure as they scale with the square power of ambient pressure. Furthermore, under supercritical conditions, the classical experimental technique of fiber suspended droplets is no longer applicable because of the drastic reduction or even annihilation of the surface tension. In the combustion of sprays or clouds gravitational effects add another difficulty due to the sedimentation of the particles and droplets. Indeed, stability of a spray or a cloud under normal gravity can only be achieved by stirring this two-phase mixture which produces a turbulent flow field. Therefore, under normal gravity conditions, the combustion characteristics of two-phase mixtures can only be obtained in turbulent flow. On the other hand, and namely for high-pressure conditions, these characteristics are in fact also strongly influenced by natural convection. The advantage of performing such experiments under reduced gravity are therefore two-fold. First, as for single droplet or single particle experiments, the effects of natural convection are removed. But, furthermore, by preventing natural sedimentation of droplets and particles, experiments can be done under non-turbulent conditions. Fundamental characteristics of two-phase combustion, such as ignition and stability limits and flame propagation rates, can be determined independently of flow and turbulence conditions and then used for model validation. It is proposed to develop a combustion facility for the International Space Station, which would make it possible to study high pressure combustion of spray and clouds as well as of single droplets and particles under microgravity. In this paper we present results of our preliminary analysis of possibilities to develop a high pressure spray and cloud combustion module for the ISS. We analyzed previous experiments on combustion of clouds and sprays under conditions of both normal and reduced gravity from the standpoint of working out the optimum techniques for the use onboard the ISS. On the basis of this analysis, some promising methods were identified and tested experimentally in parabolic flights of A300 ZERO-G aircraft in December 1998 and March 1999.

Derived from text

Drops (Liquids); Particles; Combustion; Combustion Chambers; Gravitational Effects; Microgravity; Space Station Modules

19990053996 Michigan Univ., Ann Arbor, MI USA

Laminar Soot Processes

Lin, K. -C., Michigan Univ., USA; Dai, Z., Michigan Univ., USA; Faeth, G. M., Michigan Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 133-136; In English; See also 19990053965

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Soot formation within hydrocarbon-fueled flames is an important unresolved problem of combustion science for several reasons: soot emissions are responsible for more deaths than any other combustion pollutant, thermal loads due to continuum radiation from soot limit the durability of combustors, thermal radiation from soot is mainly responsible for the growth and spread of unwanted fires, carbon monoxide associated with soot emissions is responsible for most fire deaths, and limited understanding of soot processes is a major impediment to the development of computational combustion. Thus, soot processes within laminar nonpremixed (diffusion) flames are being studied, emphasizing space-based experiments at microgravity. The study is limited to laminar flames due to their experimental and computational tractability, noting the relevance of these results to practical flames through laminar flamelet concepts. The microgravity environment is emphasized because buoyancy affects soot processes in laminar diffusion flames whereas effects of buoyancy are small for most practical flames. Results discussed here were obtained from experiments carried out on two flights of the Space Shuttle Columbia. After a brief discussion of experimental methods, results found thus far are described, including soot concentration measurements, laminar flame shapes, laminar smoke points and flame structure. The present discussion is brief.

Author

Buoyancy; Combustion Products; Laminar Flow; Soot; Diffusion Flames; Microgravity; Gravitational Effects; Spaceborne Experiments; Hydrocarbon Combustion

19990053997 Massachusetts Inst. of Tech., Dept. of Chemical Engineering, Cambridge, MA USA

Synthesis of Fullerenes in Low Pressure Benzene/Oxygen Diffusion Flames

Hebgen, Peter, Massachusetts Inst. of Tech., USA; Howard, Jack B., Massachusetts Inst. of Tech., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 137-140; In English; See also 19990053965

Contract(s)/Grant(s): NAG3-1879; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The interest in fullerenes is strongly increasing since their discovery by Kroto et al. in 1985 as products of the evaporation of carbon into inert gas at low pressure. Due to their all carbon closed-shell structure, fullerenes have many exceptional physical and chemical properties and a large potential for applications such as superconductors, sensors, catalysts, optical and electronic devices, polymers, high energy fuels, and biological and medical materials. This list is still growing, because the research on fullerenes is still at an early stage. Fullerenes can be formed not only in a system containing only carbon and an inert gas, but also in premixed hydrocarbon flames under reduced pressure and fuel rich conditions. The highest yields of fullerenes in flames are obtained under conditions of substantial soot formation. There is a need for more information on the yields of fullerenes under different conditions in order to understand the mechanisms of their formation and to enable the design of practical combustion systems for large-scale fullerene production. Little work has been reported on the formation of fullerenes in diffusion flames. In order to explore the yields of fullerenes and the effect of low pressure in diffusion flames, therefore we constructed and used a low pressure diffusion flame burner in this study.

Derived from text

Diffusion Flames; Synthesis (Chemistry); Fullerenes

19990053998 Washington Univ., Dept. of Mechanical Engineering, Saint Louis, MO USA

Monte Carlo Simulation of Nanoparticle Encapsulation in Flames

Sun, Z., Washington Univ., USA; Huertas, J. I., Los Andes Univ., Colombia; Axelbaum, R. L., Washington Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 141-144; In English; See also 19990053965

Contract(s)/Grant(s): NAG3-1910; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Two critical challenges facing the application of flames for synthesis of nanopowder materials are: (1) overcoming formation of agglomerates and (2) ensuring that the highly reactive nanopowders that are synthesized in flames can be produced in such a manner that their purity is maintained during subsequent processing. Agglomerates are produced in flames because particle formation occurs in a high temperature and high number density environment. They are undesirable in most advanced applications of powders. For example, agglomerates have a deleterious effect on compaction density, leading to voids when nanopowders are consolidated. Efforts to avoid agglomeration in flames without substantially reducing particle number density and, consequently, production rate, have had limited success. Powder purity must also be maintained during subsequent handling of nanopowders and this poses a significant challenge for any synthesis route because nanopowders, particularly metals and non-oxide ceramic powders, are inherently reactive. Impurities acquired during handling of nanopowders have slowed the advancement of the nanostructured materials industry. One promising approach that has been proposed to address these problems is nano-encapsulation. In this approach, the core particles are encapsulated in a removable material while they are within the flame but before excessive agglomeration has occurred. Condensation can be very rapid so that core particles are trapped within the condensed material and agglomeration is limited. Nano-encapsulation also addresses the handling concerns for post-synthesis processing. Results have shown that when nano-encapsulated powders are exposed to atmosphere the core particles are protected from oxidation and/or hydrolysis. Thus, handling of the powders does not require extreme care. If, for example, at the time of consolidation the encapsulation material is removed by vacuum annealing, the resulting powder remains unagglomerated and free of impurities. In this work, we described a novel aerosol model that has been developed to simulate particle encapsulation in flames. The model will ultimately be coupled to a one-dimensional spherical flame code and compared to results from microgravity flame experiments.

Derived from text

Agglomeration; Encapsulating; Flames; Monte Carlo Method; Powder (Particles); Aerosols; Mathematical Models

19990054000 Northwestern Univ., Evanston, IL USA

Filtration Combustion in Smoldering and SHS

Matkowsky, Bernard, Northwestern Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 149-152; In English; See also 19990053965

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Smolder waves and SHS (self-propagating high-temperature synthesis) waves are both examples of filtration combustion waves propagating in porous media. Smoldering combustion is important for the study of fire safety. Smoldering itself can cause damage, its products are toxic and it can also lead to the more dangerous gas phase combustion which corresponds to faster propagation at higher temperatures. In SHS, a porous solid sample, consisting of a finely ground powder mixture of reactants, is ignited

at one end. A high temperature thermal wave, having a frontal structure, then propagates through the sample converting reactants to products. The SHS technology appears to enjoy a number of advantages over the conventional technology, in which the sample is placed in a furnace and ”baked” until it is ”well done”. The advantages include shorter synthesis times, greater economy, in that the internal energy of the reactions is employed rather than the costly external energy of the furnace, purer products, simpler equipment and no intrinsic limitation on the size of the sample to be synthesized, as exists in the conventional technology. When delivery of reactants through the pores to the reaction site is an important aspect of the combustion process, it is referred to as filtration combustion. The two types of filtration combustion have a similar mathematical formulation, describing the ignition, propagation and extinction of combustion waves in porous media. The goal in each case, however, is different. In smoldering the desired goal is to prevent propagation, whereas in SHS the goal is to insure propagation of the combustion wave, leading to the synthesis of desired products. In addition, the scales in the two areas of application differ. Smoldering generally occurs at lower temperatures and propagation velocities than in SHS. Nevertheless, the two applications have much in common, so that what is learned in one application can be used to advantage in the other. We have considered a number of problems involving filtration combustion. Here we describe two such studies: (A) fingering instabilities in filtration combustion, (B) rapid filtration combustion waves driven by convection.
Derived from text
Smoldering; Filtration; Combustion Synthesis; Wave Propagation; Self Propagation; Convection

19990054002 Illinois Univ. at Urbana-Champaign, Dept. of Aeronautical and Astronautical Engineering, Urbana, IL USA
A Theory of Oscillating Edge Flames
Buckmaster, J., Illinois Univ. at Urbana-Champaign, USA; Zhang, Yi, Illinois Univ. at Urbana-Champaign, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 159-162; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

It has been known for some years that when a near-limit flame spreads over a liquid pool of fuel, the edge of the flame can oscillate relative to a frame moving with the mean speed. Each period of oscillation is characterized by long intervals of modest motion during which the edge gases radiate like those of a diffusion flame, punctuated by bursts of rapid advance during which the edge gases radiate like those in a deflagration. Substantial resources have been brought to bear on this issue within the microgravity program, both experimental and numerical. It is also known that when a near-asphyxiated candle-flame burns at zero gravity, the edge of the (hemispherical) flame can oscillate violently prior to extinction. Thus a web-surfer, turning to the NASA web-site at http://microgravity.msfc.nasa.gov, and following the trail combustion science/experiments/experimental results/ candle flame, will find photographs and a description of candle burning experiments carried out on board both the Space-shuttle and the Russian space station Mir. A brief report can also be found in the proceedings of the Fourth Workshop. and recently, in a third microgravity program, the leading edge of the flame supported by injection of ethane through the porous surface of a plate over which air is blown has been found to oscillate when conditions are close to blow-off. A number of important points can be made with respect to these observations: It is the edge itself which oscillates, advancing and retreating, not the diffusion flame that trails behind the edge; oscillations only occur under near limit conditions; in each case the Lewis number of the fuel is significantly larger than 1; and because of the edge curvature, the heat losses from the reacting edge structure are larger than those from the trailing diffusion flame. We propose a general theory for these oscillations, invoking Occam’s ’Law of Parsimony’ in an expanded form, to wit: The same mechanism is responsible for the oscillations in all three experiments; and no new mechanism is invoked (Occam’s original ’Razor’). Such a strategy eliminates Marangoni effects as the source, for these are absent in the second and third experiments. and it eliminates arguments that point to numerically predicted gas eddies as the source, a new mechanism, unelucidated. Indeed, we hypothesize that the essential driving mechanism for the instability is a combination of large Lewis number and heat losses from the reacting structure near the flame edge. Instabilities driven by these mechanisms are commonplace in 1D configurations. Chemical reactor theory, for example, leads to system responses which mimic the response of the candle flame - steady flame, oscillations, extinction. In a combustion context, oscillating instabilities were first reported for diffusion flames in a theoretical study by Kirkby and Schmitz, and here also the instabilities are associated with near-extinction conditions, large Lewis numbers, and heat losses. and deflagrations will oscillate if the Lewis number is large enough, oscillations that are exacerbated when heat losses are present, whether global or to a surface.
Derived from text
Diffusion Flames; Leading Edges; Oscillations; Flame Stability; Flame Propagation; Lewis Numbers; Mathematical Models; Fuel Combustion

19990054004 Northwestern Univ., McCormick School of Engineering and Applied Science, Evanston, IL USA
Diffusion Flames: Extinction and Stability
Matalon, Moshe, Northwestern Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 167-170;

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Some recent results, concerning extinction limits and stability in spherical diffusion flames, cellular diffusion flames and oscillations in diffusion flames are summarized. Results obtained from experiments carried out in microgravity ground facilities are presented.

CASI

Diffusion Flames; Flame Stability; Microgravity; Gravitational Effects

19990054005 Sandia National Labs., Combustion Research Facility, Livermore, CA USA

Hydrodynamic Instability and Thermal Coupling in a Dynamic Model of Liquid-Propellant Combustion

Margolis, S. B., Sandia National Labs., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 171-174; In English; See also 19990053965

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For liquid-propellant combustion, the Landau/Levich hydrodynamic models have been combined and extended to account for a dynamic dependence of the burning rate on the local pressure and temperature fields. Analysis of these extended models is greatly facilitated by exploiting the realistic smallness of the gas-to-liquid density ratio rho. Neglecting thermal coupling effects, an asymptotic expression was then derived for the cellular stability boundary A(sub p)(k) where A(sub p) is the pressure sensitivity of the burning rate and k is the disturbance wavenumber. The results explicitly indicate the stabilizing effects of gravity on long-wave disturbances, and those of viscosity and surface tension on short-wave perturbations, and the instability associated with intermediate wavenumbers for critical negative values of A(sub p). In the limit of weak gravity, hydrodynamic instability in liquid-propellant combustion becomes a long-wave, instability phenomenon, whereas at normal gravity, this instability is first manifested through O(1) wavenumbers. In addition, surface tension and viscosity (both liquid and gas) each produce comparable effects in the large-wavenumber regime, thereby providing important modifications to the previous analyses in which one or more of these effects was neglected. For A(sub p)= O, the Landau/Levich results are recovered in appropriate limiting cases, although this typically corresponds to a hydrodynamically unstable parameter regime for p is much less than 1. In addition to the classical cellular form of hydrodynamic stability, there exists a pulsating form corresponding to the loss of stability of steady, planar burning to time-dependent perturbations. This occurs for negative values of the parameter A(sub p), and is thus absent from the original Landau/Levich models. In the extended model, however, there exists a stable band of negative pressure sensitivities bounded above by the Landau type of instability, and below by this pulsating form of hydrodynamic instability. Indeed, nonsteady modes of combustion have been observed at low pressures in hydroxylammonium nitrate (HAN)-based liquid propellants, which often exhibit negative pressure sensitivities. While nonsteady combustion may correspond to secondary and higher-order bifurcations above the cellular boundary, it may also be a manifestation of this pulsating type of hydrodynamic instability. In the present work, a nonzero temperature sensitivity is incorporated into our previous asymptotic analyses. This entails a coupling of the energy equation to the previous purely hydrodynamic problem, and leads to a significant modification of the pulsating boundary such that, for sufficiently large values of the temperature-sensitivity parameter, liquid-propellant combustion can become intrinsically unstable to this alternative form of hydrodynamic instability. For simplicity, further attention is confined here to the inviscid version of the problem since, despite the fact that viscous and surface-tension effects are comparable, the qualitative nature of the cellular boundary remains preserved in the zero-viscosity limit, as does the existence of the pulsating boundary. The mathematical model adopts the classical assumption that there is no distributed reaction in either the liquid or gas phases, but now the reaction sheet, representing either a pyrolysis reaction or an exothermic decomposition at the liquid/gas interface, is assumed to depend on local conditions there.

Derived from text

Dynamic Models; Flow Stability; Thermodynamic Coupling; Propellant Combustion; Liquid Rocket Propellants; Temperature Dependence; Gas-Liquid Interactions; Asymptotic Methods; Flame Stability

19990054006 University of Southern California, Dept. of Mechanical Engineering, Los Angeles, CA USA

Low-Temperature Oxidation Reactions and Cool Flames at Earth and Reduced Gravity

Pearlman, Howard, University of Southern California, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 175-178; In English; See also 19990053965

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Non-isothermal studies of cool flames and low temperature oxidation reactions in unstirred closed vessels are complicated by the perturbing effects of natural convection at earth gravity. Buoyant convection due to self-heating during the course of slow reaction produces spatio-temporal variations in the thermal and thus specie concentration fields due to the Arrhenius temperature

dependence of the reaction rates. Such complexities have never been quantitatively modeled and were the primary impetus for the development of CSTR's (continuously stirred tank reactors) 30 years ago. While CSTR's have been widely adopted since they offer the advantage of spatial uniformity in temperature and concentration, all gradients are necessarily destroyed along with any structure that may otherwise develop. Microgravity offers a unique environment where buoyant convection can be effectively minimized and the need for stirring eliminated. Moreover, eliminating buoyancy and the need for stirring eliminates complications associated with the induced hydrodynamic field whose influence on heat transport and hot spot formation, hence explosion limits, is not fully realized. The objective of this research is to quantitatively determine and understand the fundamental mechanisms that control the onset and evolution of low temperature reactions and cool flames in both static and flow reactors. Microgravity experiments will be conducted to obtain benchmark data on the structure (spatio-temporal temperature, concentration, flow fields), the dynamics of the chemical fronts, and the ignition diagrams (pressure vs. temperature). Ground-based experiments will be conducted to ascertain the role of buoyancy. Numerical simulations including detailed kinetics will be conducted and compared to experiment.

Derived from text

Low Temperature; Oxidation; Flames; Flame Temperature; Microgravity; Gravitational Effects; Chemical Reactors; Static Tests; Buoyancy; Free Convection

19990054007 Naval Research Lab., Lab. for Computational Physics and Fluid Dynamics, Washington, DC USA

Detailed Multidimensional Simulations of the Structure and Dynamics of Flames

Patnaik, G., Naval Research Lab., USA; Kailasanath, K., Naval Research Lab., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 179-182; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Numerical simulations in which the various physical and chemical processes can be independently controlled can significantly advance our understanding of the structure, stability, dynamics and extinction of flames. Therefore, our approach has been to use detailed time-dependent, multidimensional, multispecies numerical models to perform carefully designed computational experiments of flames on Earth and in microgravity environments. Some of these computational experiments are complementary to physical experiments performed under the Microgravity Program while others provide a fundamental understanding that cannot be obtained from physical experiments alone. In this report, we provide a brief summary of our recent research highlighting the contributions since the previous microgravity combustion workshop. There are a number of mechanisms that can cause flame instabilities and result in the formation of dynamic multidimensional structures. In the past, we have used numerical simulations to show that it is the thermo-diffusive instability rather than an instability due to preferential diffusion that is the dominant mechanism for the formation of cellular flames in lean hydrogen-air mixtures. Other studies have explored the role of gravity on flame dynamics and extinguishment, multi-step kinetics and radiative losses on flame instabilities in rich hydrogen-air flames, and heat losses on burner-stabilized flames in microgravity. The recent emphasis of our work has been on exploring flame-vortex interactions and further investigating the structure and dynamics of lean hydrogen-air flames in microgravity. These topics are briefly discussed after a brief discussion of our computational approach for solving these problems.

Derived from text

Flame Propagation; Flames; Gravitational Effects; Mathematical Models; Flame Stability; Computerized Simulation; Microgravity; Fuel-Air Ratio; Vortices

19990054009 Bremen Univ., Center of Applied Microgravity and Space Technology, Germany

Formaldehyde-PLIF Detection of Cool-Flame Reactions During Two Stage Ignition of Alkane Droplets

Koenig, J., Bremen Univ., Germany; Eigenbrod, C., Bremen Univ., Germany; Rath, H. J., Bremen Univ., Germany; Grebner, D., Jena Univ., Germany; Hein, J., Jena Univ., Germany; Triebel, W., Jena Univ., Germany; Fifth International Microgravity Combustion Workshop; May 1999, pp. 189-192; In English; See also 19990053965

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Whenever alkane fuels have to reside partially or fully mixed in an oxidizing atmosphere at high temperatures, ignition can occur in a multistage mode, subsequently following completely different schemes of oxidation. This behavior is experimentally well known for premixed gases and for multiphase systems. Moreover it is an apparent problem in prominent technical applications such as IC-combustion engines as well as when designing continuous flow reactors for high pressures and temperatures with large premixing zones. If fuel is used in liquid phase, mixing, upheating and the subsequent ignition and combustion takes place in a transient field of temperature and concentration. This holds true, from the instant when the fuel is inserted as a spray up to beyond the time the liquid is completely vaporized. The understanding and modeling of the process requires a consequent coupling of the physical processes with a suitable chemical kinetic of the fuel covering the full range of temperatures encountered in the entire process. Numerical results are in reasonable good agreement with experiments for homogeneous gas phase ignition only.

In particular the low temperature mechanism is very complex, and proceeds via different submechanisms sensibly governed by temperature. The frame of this mechanism is given by the subsequent oxidation of the parent fuel molecule, forming large alkylhydroperoxy-radicals. Exothermal ”breakup” of these radicals is the major step to form a large amount of aldehydes and OH (and H02) -radicals, which promote the subsequent reaction by chain branching. Thermal runaway of the cool flame is inhibited by the second addition of oxygen to the alkylperoxy -radical, which is balanced by a backward reaction becoming important beyond a temperature of about 700K. This balancing features the very important and characteristic negative temperature coefficient of the low temperature mechanism. Since the low temperature mechanism can proceed in a rather wide range of stoichiometric mixtures, cool flame ignition can occur at very lean conditions, and is supposed to play a very important role favoring subsequent hot flame ignition. In the presented work, the formaldehyde molecule HCOH has been selectively detected as key species in the gas phase around a single, n-heptane drenched porous sphere during the process of two stage-selfignition by means of Planar Laser Induced Fluorescence PLIF. Currently the obtained concentration field yields qualitative data. Methods are under investigation to prepare the equipment for a quantitative interpretation of the images. to be able to gain the experimental data into a one dimensional numerical model, all experiments were carried out under microgravity at the Bremen Drop Tower.
Derived from text

Alkanes; Formaldehyde; Laser Induced Fluorescence; Qualitative Analysis; Fuel Combustion; Drops (Liquids); Microgravity; Chain Reactions (Chemistry); Ignition

19990054011 Southwest Sciences, Inc., Santa Fe, NM USA

Real Time Quantitative 3-D Imaging of Diffusion Flame Species

Kane, D. J., Southwest Sciences, Inc., USA; Pilgrim, J. S., Southwest Sciences, Inc., USA; Goldmeer, J. S., Southwest Sciences, Inc., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 197-200; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Ideally, to bridge the gap between chemistry and fluid mechanics in microgravity combustion, species concentrations and temperature profiles are needed throughout the flame. However, restrictions associated with performing measurements in reduced gravity, especially size and weight considerations, have generally limited microgravity combustion studies to the capture of flame emissions on film or video laser Schlieren imaging and (intrusive) temperature measurements using thermocouples. Given the development of detailed theoretical models, more sophisticated studies are needed to provide the kind of quantitative data necessary to characterize the properties of microgravity combustion processes as well as provide accurate feedback to improve the predictive capabilities of the computational models. Over the past ten years, Southwest Sciences has focused its research on the high sensitivity, quantitative detection of gas phase species using diode lasers. Our research approach combines three innovations in an experimental system resulting in a new capability for nonintrusive measurement of major combustion species. FM spectroscopy or high frequency wavelength modulation spectroscopy (WMS) have recently been applied to sensitive absorption measurements at Southwest Sciences and in other laboratories using GaAlAs or InGaAsP diode lasers in the visible or near-infrared as well as lead-salt lasers in the mid-infrared spectral region. Because these lasers exhibit essentially no source noise at the high detection frequencies employed with this technique, the achievement of sensitivity approaching the detector shot noise limit is possible. Such high sensitivity permits the in situ detection of chemical species of interest such as water, methane, O2, CO, CO2, OH, etc.
Derived from text

Absorption Spectroscopy; Laser Spectroscopy; Nonintrusive Measurement; Gas Mixtures; Concentration (Composition); Imaging Techniques; Diffusion Flames; Quantitative Analysis; Microgravity

19990054016 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Hardthausen-am-Kocher, Germany

Oxide Layer Effects in Metal Particle Combustion

Meinkoehn, Dirk, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Fifth International Microgravity Combustion Workshop; May 1999, pp. 219-222; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

By and large, all current combustion modelling for metal particles may be traced back to a common origin. This is the original formulation by Law which in essence is based on the concept of a vapour-phase flame enveloping the particle. The Law model is set up in close analogy with the combustion model for a hydrocarbon fuel droplet where gaseous oxides CO2 and H2O are produced. The elements grouped as ’metals’ for combustion applications are distinguished by a heat of combustion which is large in comparison to that of hydrocarbons. A convenient physical argument shows that the large heat of combustion entails a strong preference of the metal oxides for the condensed state of aggregation, so that the physics of metal combustion must differ from that of hydrocarbon combustion. It is an essential shortcoming of the Law model that the condensed-phase nature of the reaction products is not properly recognized. Typically, the surface of metal particles in combustion is covered by a condensed-phase oxide layer. Some of its evolutions result in ignition, extinction or oxide cap formation which designate important combustion character-

istics. These are outside the Law model since it doesn't properly provide for the presence and the evolution of the oxide layer. With respect to a flame envelope, the metal oxide may be grouped in two fractions. Metal oxide which is outside the flame envelope condenses into micron-size smoke particles which eventually escape with the gaseous exhaust. The other fraction of the oxide is in between the flame envelope and the particle and mostly condenses on the particle surface where it forms a uniform or nonuniform surface layer. The Law model makes the indiscriminate assumption of a uniform surface layer of negligible transport resistance, but ignition, extinction and cap formation arise from surface layers of strong nonuniformity and strong transport resistance. The importance of these effects, for instance in rocket propulsion with metallized fuels and propellants, is well documented. Boron and aluminium represent primary examples of metals which are used as high-energy additives. For boron, a thick oxide layer is found to prevent ignition and effective combustion. In contrast with boron, aluminium ignites easily but has the tendency to form oxide caps which are seen as causing major problems in propulsion applications. Ignition, extinction and the onset of cap formation are associated with critical states of the particle where a sudden change in the reaction mode occurs. Such branching phenomena are easily disturbed by even small perturbations, so that their experimental investigation is expected to be much easier under reduced gravity. These model deficiencies as well as ignition/extinction for critical Marangoni numbers are presented.
Derived from text
Metal Combustion; Metal Particles; Mathematical Models; Marangoni Convection; Microgravity; Gravitational Effects; Ignition; Extinction

19990054018 California Univ., Center for Energy and Combustion Research, San Diego, CA USA
Flame Histories in Heptane Droplet Combustion
Williams, Forman A., California Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 229-232; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The present communication reports recent theoretical studies at University of California-San Diego (UCSD) focused on predicting flame histories and extinction conditions. An asymptotic analysis, treating the gas-liquid density ratio and the stoichiometric air-fuel ratio as small parameters, is outlined, and some comparisons with experimental results are made. First, an identification of different regimes of droplet combustion will be introduced.
Derived from text
Drops (Liquids); Flames; Heptanes; Hydrocarbon Combustion; Flame Propagation

19990054026 NASA Glenn Research Center, Cleveland, OH USA
Effects of Buoyancy on the Flowfields of Lean Premixed Turbulent V-Flames
Cheng, R. K., California Univ., Lawrence Berkeley Lab., USA; Bedat, B., California Univ., Lawrence Berkeley Lab., USA; Yegian, D. T., California Univ., Lawrence Berkeley Lab., USA; Greenberg, P., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 263-266; In English; See also 19990053965
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Open laboratory turbulent flames used for investigating fundamental flame turbulence interactions are greatly affected by buoyancy. Though much of our current knowledge is based on observations made in open flames, buoyancy effects are usually not considered in data interpretation, numerical analysis or theories. This inconsistency remains an obstacle to merging experimental observations and theoretical predictions. to better understanding the effects of buoyancy, our research focuses on steady lean premixed flames propagating in fully developed turbulence. We hypothesize that the most significant role of buoyancy forces on these flames is to influence their flowfields through a coupling with the mean and the fluctuating pressure fields. This coupling relates to the elliptical problem that emphasizes the importance of the upstream, wall and downstream boundary conditions in determining all aspects of flame propagation. Therefore, buoyancy has the same significance as other parameters such as flow configuration, and flame geometry.
Derived from text
Buoyancy; Flame Propagation; Premixed Flames; Turbulent Flames; Turbulence Effects; Fuel Combustion; Gravitational Effects; Microgravity; Velocity Distribution

19990054029 California Univ., Mechanical and Aerospace Engineering Dept., Irvine, CA USA
Effects of Gravity on Sheared Turbulent Nonpremixed Flames
Elghobashi, S. E., California Univ., USA; Zhong, R., California Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 275-278; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

In the present study, we use the method of direct numerical simulation (DNS) to obtain the instantaneous, three-dimensional flow field of a turbulent nonpremixed flame subjected to uniform shear. The fuel and oxidant initially exist as two separate parallel

streams. As the reactants mix, chemical reaction takes place and the resulting exothermic energy creates density gradients. In the presence of a gravity field, the spatial and temporal distributions of the induced buoyancy forces depend on the local density gradients, the magnitude and direction of the gravitational acceleration. Our objective is to gain an understanding of the multi-way interaction between turbulence, chemical reaction, imposed shear and buoyancy in nonpremixed flames. The instantaneous velocity is the sum of the prescribed mean velocity and the deviation from the mean. Thus, only the velocity deviation needs to be determined. The governing equations and numerical procedure are provided. The value of the non-dimensional shear parameter S is prescribed equal to 1 in all simulations, which results in a strain number St = (v(sub rms)/l)/S = 0.4 at the initial time t = 1.5. St represents the ratio of the strain rate of the energy-containing eddies (large-scale strain rate) to that of the mean flow. The shear flow simulations require a parallelpiped computational domain instead of a cube. The longer side length in the x-direction allows the large vortical structures to develop in time without violating the periodic boundary condition imposed in the streamwise direction. This boundary condition is satisfied by insuring that the two-point Eulerian velocity correlations vanish within an axial distance smaller or equal to half the domain length in the x-direction. Periodic boundary conditions are also imposed in the spanwise (y) direction. Outflow boundary conditions are imposed at the top and bottom z planes of the domain. The grid used for the computations consists of 192x96x96 mesh points in the x, y and z directions respectively.
Derived from text
Direct Numerical Simulation; Gravitational Effects; Turbulent Flames; Three Dimensional Flow; Flow Distribution; Shear Flow; Chemical Reactions; Turbulence; Buoyancy; Fuel Combustion

19990054033 Japan Space Utilization Promotion Center, Advanced Combustion Science Utilizing Microgravity, Tokyo, Japan
Flame Propagation of Spray Compound Mixture in a Constant Volume Vessel
Yoshizaki, T., Hiroshima Univ., Japan; Yamaguchi, M., Hiroshima Univ., Japan; Nishida, K., Hiroshima Univ., Japan; Hiroyasu, H., Kinki Univ., Japan; Yoshida, H., Maritime Safety Agency, Japan; Sakuraya, T., Japan Space Utilization Promotion Center, Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 293-296; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Flames that are sustained in a spray compound mixture are considered to be similar to the start of flame kernels and the subsequent flame development in the evaporating gasoline spray in spark ignition engines. This is especially so in the case of direct injection stratified charge (DISC) engine, in which a gasoline spray is injected directly into the cylinder and ignited by an electric spark before evaporation of the spray drops is completed. The gasoline spray is heated and evaporated by the hot spark discharge plasma, after which the flame kernel develops and the flame propagates in the gaseous mixture containing the droplets. Moreover, an investigation into the flame propagation of the spray compound mixture leads to a further understanding of spray combustion, such as diesel combustion and gas turbine combustion. Many various studies have been conducted on the ignition characteristics of spray flows. The effects of the droplet diameter, fuel concentration and flow condition in the spray on the ignition characteristics were investigated in these studies. Mainly their interest was focused on the minimum ignition energy necessary to maintain successful ignition of the spray flow. Some of these studies tried to estimate the gaseous fuel concentration in the spray flow, but did not adopt the gaseous fuel concentration as the main variable parameter in the experiment. The flame propagation characteristics have been studied in spray flows and spray compound mixt1999063ures. The effects of the droplet diameter, fuel concentration and flow condition of the spray flow and the mixture on the flame propagation velocity (flame speed) and the lean limit of the flame propagation were examined in these studies. However, detailed analyses of the effects of the gaseous fuel (vaporized fuel) fraction in the spray compound mixture on the flame propagation characteristics were not made, except for a few studies. Even in these studies, the compounded spray drops had a velocity relative to the ambient gas, and were not distributed homogeneously because these experiments were performed under conditions of normal gravity. Moreover, the effect of buoyancy reflected in the results is not negligible under normal gravity. Thus, fundamental information of the ignition and flame propagation characteristics in the spray compound mixture is required from an experiment in which fractions of the gaseous fuel and droplets are independently and widely changed under microgravity.
Derived from text
Flame Propagation; Fuel Sprays; Gas Mixtures; Gaseous Fuels; Fuel Injection; Fluid Injection; Fuel Combustion

19990054034 Japan Space Utilization Promotion Center, Advanced Combustion Science Utilizing Microgravity, Tokyo, Japan
Pressure Effects on Combustion of Methanol and Methanol-Docecanol Droplets
Okai, K., Tokyo Univ., Japan; Ono, Y., Tokyo Univ., Japan; Muriue, O., Tokyo Univ., Japan; Tsue, M., Tokyo Univ., Japan; Kono, M., Tokyo Univ., Japan; Sato, J., Ishikawajima-Harima Heavy Industries Co. Ltd., Japan; Dietrich, D. L., NASA Glenn Research Center, USA; Williams, F. A., California Univ., San Diego, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 299-302; In English; See also 19990053965
Contract(s)/Grant(s): NAG3-1689; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The objective of this research is to improve understanding of the combustion of binary fuel mixtures in the vicinity of the critical point. Fiber-supported single droplets and two-droplet arrays of methanol and of mixtures of methanol and 1-dodecanol, initially 0.9 mm in diameter, were burned in room-temperature air at pressures from 0.1 MPa to 9.0 MPa in the NASA Lewis 2.2-second drop tower. The work is a continuation of a collaborative Japan-US research effort designed to increase knowledge of high-pressure combustion of fuel sprays, relevant to application in propulsive and power-production devices such as Diesel engines. Some previous publications from this cooperative program may be cited. All of the previous experiments concerned alkanes and alkane mixtures. The new research reported here addresses alcohols and alcohol mixtures, to ascertain the degree to which previous results for alkanes extend to alcohols. There have been many previous experimental studies of methanol droplet combustion and a few of alcohol mixtures, but not at the high pressures of interest here. There is some experimental information on methanol droplet combustion at elevated pressure but none on the alcohol mixtures extending to critical pressures, as in the present study.
Derived from text
Alcohols; Binary Mixtures; Drops (Liquids); Fuel Sprays; High Pressure; Pressure Effects; Fuel Combustion; Hydrocarbon Combustion; Drop Size

19990054038 NASA Glenn Research Center, Cleveland, OH USA
Diffusive and Radiative Transport in Fires (DARTFire): Opposed-Flow Flame Spread in Low-Velocity Flows
Altenkirch, R. A., Mississippi State Univ., USA; Olson, S. L., NASA Glenn Research Center, USA; Deering, J. L., Washington State Univ., USA; Tang, L., Mississippi State Univ., USA; Bhattacharjee, S., San Diego State Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 317-320; In English; See also 19990053965
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For flames spreading into a low-velocity flow that can only be obtained in microgravity, we have observed behavior that is different from that which is obtained at higher velocities where radiative effects are unimportant and species transport is relatively fast. Unfortunately, lack of a large body of low-gravity flame spread experimental data inhibits progress in developing an understanding of the physics of low-velocity, opposed-flow flame spread phenomena. Recent DARTFire sounding rocket experimental studies though, coupled with developing theory and modelling, have allowed some strides in understanding to be made, on which we report here. Four launches to date have resulted in six experiments for opposed-flow flame spread over a thick PMMA sample. During the 6 min microgravity period, the PMMA samples were ignited, and steady flame spread was studied under varied flow velocity, oxidizer atmospheric conditions, and, because radiative heat transfer is so important in these slowly spreading flames, external radiant flux. These were the first attempts at such experimental control and measurement in microgravity. A recent reflight of the Solid Surface Combustion Experiment (SSCE) has demonstrated, as modelling predicts, that for the thick fuel of the DARTFire experiment, flame spread in a quiescent environment is a transient process evolving from ignition to extinction on the order of 600 s (Altenkirch et al., 1999). Further study then of the effects of radiation in the very low-velocity opposing flows is of interest in understanding the transition from steady, sustained spread to the unsteady evolution to extinction as the opposing flow is reduced further and eventually removed.
Derived from text
Diffusivity; Flame Propagation; Flow Velocity; Microgravity; Radiative Heat Transfer; Radiant Flux Density

19990054039 NASA Glenn Research Center, Cleveland, OH USA
Flame Spread Across Liquids: Experimental Results
Ross, H. D., NASA Glenn Research Center, USA; Miller, F. J., National Center for Microgravity Research on Fluids and Combustion, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 321-324; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The goal of our research on flame spread across a pool of liquid fuel is the quantitative identification of the mechanisms that control the rate and nature of flame spread when the initial temperature of the liquid pool is below the fuel's flash point temperature. Besides numerous experiments in drop towers and 1 g laboratories, we have flown five microgravity (mu-g) experiments on sounding rockets. As described in earlier papers, the first three flights examined the effect of forced opposed airflow over a 2.5 cm deep x 2 cm wide x 30 cm long pool of 1-butanol in mu-g. It was found that the flame spread is much slower and steadier than in 1 g where flame spread has a pulsating character. It was speculated that the flame spread in mu-g resembled the character of pseudo-uniform spread in 1 g; Ito et al later confirmed this conclusively in 1 g experiments. Much of the mu-g flame is also farther from the surface, dimmer, and with less soot, when compared to the 1 g flame. Three-dimensional liquid-phase flow patterns that control the liquid preheating were discovered in both 1 g and mu-g. Our numerical model, restricted to two dimensions, had predicted faster, pulsating flame spread in mu-g for opposed airflow. In examining the differences in the dimensionality of the model and experiment, it was noted that the experiment allowed gas expansion in the lateral direction (across the width of the pool), for which the model could not account. Such lateral expansion could reduce the expansion in the forward and upward direc-

tions. Because only these latter directions could be modeled, it was decided to artificially reduce the gas thermal expansion in the predictions. When this was done, satisfactory agreement could be obtained between the predicted and observed spread rates and the steadiness of the spread in microgravity. In 1 g, however, the predicted flame spread character also changed to pseudo-uniform, which disagreed with our 1 g experiments where the spread is pulsating. It was then speculated that gas-phase buoyant flow might oppose the lateral gas expansion, so that the 1 g experiments retained their pulsating flame spread character. If this speculation was valid, a difference in lateral gas expansion should be observable when comparing 1 g and mu-g experiments. Specifically, it was anticipated that greater flow divergence caused by lateral expansion would be measured in mu-g in the absence of a buoyant flow directed towards the flame.
Derived from text
Flame Propagation; Combustion Physics; Mathematical Models; Gravitational Effects; Microgravity; Unsteady Flow; Liquid Fuels; Fuel Combustion

19990054040 California Univ., Dept. of Mechanical and Aerospace Engineering, Irvine, CA USA
Flame Spread Across Liquids: Numerical Modelling
Kim, Inchul, California Univ., USA; Li, Huaidong, California Univ., USA; Sirignano, William A., California Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 325-328; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The goals of our theoretical/computational program are to study flame spread over liquid fuel pools to guide and explain the microgravity experimental research of H. Ross and F. Miller and to provide fundamental insight for the flame spread phenomenon. The approach has involved the development and exercise of planar 2-D, axisymmetric, and 3-D codes for the unsteady two-phase flow. The gas-phase model accounts for multicomponent reacting flow. Thermocapillary and gravity flows are included in the models. During the past year, we concentrated on comparisons of the model with existing axisymmetric experimental data in order to validate the model and to establish, to the extent possible, the appropriate global chemical kinetics to be used for n-propanol and n-butanol. We also examined the effect of liquid fuel depth on planar flame spread with and without forced, opposed airflow in order to support the sounding rocket flight tests. The depth of a liquid fuel pool affects the heating of the liquid fuel pool and thus the liquid fuel surface temperature ahead of the flame. A three-dimensional code has been developed and is being benchmarked: it will be used to explain the effects of fuel pool width and various edge effects.
Derived from text
Flame Propagation; Liquid Fuels; Mathematical Models; Unsteady Flow; Fuel Combustion

19990054041 Kentucky Univ., Dept. of Mechanical Engineering, Lexington, KY USA
The Three-D Flow Structures of Gas and Liquid Generated by a Spreading Flame Over Liquid Fuel
Tashtoush, G., Kentucky Univ., USA; Ito, A., Kentucky Univ., USA; Konishi, T., Kentucky Univ., USA; Narumi, A., Kentucky Univ., USA; Saito, K., Kentucky Univ., USA; Cremers, C. J., Kentucky Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 329-332; In English; See also 19990053965
Contract(s)/Grant(s): NCCw-60; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

We developed a new experimental technique called: Combined laser sheet particle tracking (LSPT) and laser holographic interferometry (HI), which is capable of measuring the transient behavior of three dimensional structures of temperature and flow both in liquid and gas phases. We applied this technique to a pulsating flame spread over n-butanol. We found a twin vortex flow both on the liquid surface and deep in the liquid a few mm below the surface and a twin vortex flow in the gas phase. The first twin vortex flow at the liquid surface was observed previously by NASA Lewis researchers, while the last two observations are new. These observations revealed that the convective flow structure ahead of the flame leading edge is three dimensional in nature and the pulsating spread is controlled by the convective flow of both liquid and gas.
Author
Flame Propagation; Liquid Fuels; Liquid Surfaces; Fuel Combustion; Three Dimensional Flow; Vortices; Convective Flow

19990054046 National Center for Microgravity Research on Fluids and Combustion, Cleveland, OH USA
Thickness Effects on Fuel Flammability (TEOFF)
Ferkul, Paul, National Center for Microgravity Research on Fluids and Combustion, USA; Pettegrew, Richard D., National Center for Microgravity Research on Fluids and Combustion, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 353-356; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The U-shaped flammability boundary for thermally-thin fuels burning in low-speed flows is well-established. The importance of radiative loss is evident in leading to flame extinction when the flow velocity (or ambient oxygen concentration) is reduced sufficiently. This quenching extinction occurs when the flame power output decreases, and the radiative heat loss rate

becomes a significant fraction of the total combustion heat release from the flame. The existence of a similar boundary is hypothesized for fuels which are not thermally thin. For such fuels, heat conduction into the depth of the solid will become an increasingly important parameter as the solid thickness is increased. Thus, one can imagine that different materials will exhibit different burning characteristics as their thickness is increased away from the thermally-thin limit. When solid conductivity begins to become important, materials with different thermal diffusivities may have a different material flammability ranking, compared to their thermally-thin ranking. In effect, conduction heat loss in depth of the solid will manifest itself in different degrees for different materials. Hence, in order to determine an accurate and absolute material flammability ranking, the effect of solid thickness must be accounted for. In addition, there are other related (secondary) effects which will be investigated. Some materials will form a char layer that tends to inhibit pyrolysis of fuel beneath it. This barrier will have implications for the flammability ranking as well. Other materials will tend to sputter when they burn, sending off flaming bits in many directions. Clearly, a material's ranking must consider the susceptibility of a burning section to ignite another section by such a mechanism.
Derived from text
Fuel Combustion; Flammability; Thickness; Microgravity

19990054047 National Inst. of Standards and Technology, Gaithersburg, MD USA
The Extinction of Low Strain Rate Diffusion Flames by a Suppressant
Hamins, A., National Inst. of Standards and Technology, USA; Yang, J., National Inst. of Standards and Technology, USA; Puri, I. K., Illinois Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 357-360; In English; See also 19990053965
Contract(s)/Grant(s): NASA Order C-32066-J; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

This paper describes plans for an experimental and computational study on the structure and extinction of low strain rate diffusion flames by a suppressant added to the oxidizer stream. Stable low strain rate flames will be established through ground based reduced gravity experiments using the 2.2 s drop tower. A variety of agents will be investigated, including both physically and chemically acting agents (He, N2, CO2, and CF3Br) for flames burning methane and propane. A computational model of flame structure and extinction will be modified to include radiative losses, which is thought to be a significant heat loss mechanism at low strain rates.
Derived from text
Diffusion Flames; Extinction; Microgravity; Retarding; Mathematical Models; Computerized Simulation

19990054049 Michigan Univ., Dept. of Mechanical Engineering, Dearborn, MI USA
Effect of Lewis Number on Radiative Extinction and Flamelet Modeling
Shamim, T., Michigan Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 365-368; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Lewis number, which relates the rates of heat and mass diffusion of various species, is an important parameter in combustion studies. Despite the early recognition of the importance of unequal rates of diffusion on the flame's structure and stability, the assumption of unity Lewis number has been common in many combustion modeling approaches. It is a convenient, and in many cases, a reasonable assumption which provides an ease in obtaining analytical and numerical solutions and helps simplifying the experimental data interpretations. However, in some applications, this assumption may lead to significantly erroneous conclusions. For example, in the turbulent flames, the effect of non-unity Lewis number may be responsible for the discrepancies between the measured and the predicted mass fraction of combustion intermediates. This effect has also been reported to influence the flame's extinction limit and to induce temperature oscillations in diffusion flame. The present study is motivated by realizing the importance of Lewis number effects and its influence on a couple of combustion phenomena of recent interest, namely, transient effects in flamelet modeling and radiative extinction. Microgravity environment and hence the absence of buoyancy effect is essential for gaining better understanding of these effects. In the present study, the influence of non-unity Lewis number due to unequal rates of heat and mass diffusion is considered. Transient effects are simulated by considering flames subjected to time dependent fluctuations in reactant concentrations, reactant temperatures, and partial premixing. The governing equations were reduced by using the assumptions of axisymmeteric, negligible body forces, negligible viscous dissipation, and negligible Dufour effect. The radiative heat flux is modeled by using the emission approximation. to focus on the physical understanding of the problem, the chemistry was kept simple by employing a single step overall reaction. The governing equations were solved by using the Numerical Method of Lines employing a second order 3-point central differencing for spatial discretization and an implicit backward differentiation formula (BDF) for temporal integration.
Derived from text
Lewis Numbers; Extinction; Combustion Chemistry; Diffusion Flames; Mathematical Models; Turbulent Flames; Microgravity

19990054050 SRI International Corp., Molecular Physics Lab., Menlo Park, CA USA

Quantitative Interpretation of Optical Emission Sensors for Microgravity Experiments

Jeffries, Jay B., SRI International Corp., USA; Smith, Gregory P., SRI International Corp., USA; Crosley, David R., SRI International Corp., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 371-374; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Microgravity flight experiments uniquely test our knowledge and understanding of the coupling between chemistry and fluid mechanics. However, compared to ground based laboratory experiments the number of useful diagnostic tools suitable for microgravity environments is severely limited by the space, weight, power consumption, and operator complexity requirements. One of the available tools is the observation of optical emission, and total emission has already proven useful for observations of stable ”flame balls” on the space shuttle. Wavelength resolved tomographic measurements of flame emission offer the promise of diagnostics to test our understanding of flame chemistry and structure. Individual emissions from electronically excited radicals, e.g., CH*, OH*, and C2*, can be identified in a methane/air flame. Spatially resolved measurements of the intensity of this resolved optical emission from a specific excited molecule enable chemically resolved flame structure studies. Wavelength resolved emission measurements to determine such structure in diffusion flames are being readied for flight experiments by a group at Yale headed by Profs. Smooke and Long. A quantitative relationship between emission intensity and flame properties, as expressed by a flame model, is needed for species specific optical emission measurements to fulfill its promise. The Yale group compared models and measurements of optical emission in laboratory tests at 1-g. Unfortunately, these experiments show disagreement between measurement and state-of-the-art flame models by over a factor of 50. Therefore, an improved chemical mechanism for optical emission from flames is needed to enable quantitative tests of microgravity flame models. The connection between excited state emission and flame chemistry is not yet adequate.

Derived from text

Light Emission; Reaction Kinetics; Combustion Chemistry; Flames; Scientific Visualization

19990054054 Physical Sciences, Inc., Andover, MA USA

Hyperspectral Imaging of Flame Spread over Solid Fuel Surfaces using Adaptive Fabry-Perot Filters

Rawlins, W. T., Physical Sciences, Inc., USA; Marinelli, W. J., Physical Sciences, Inc., USA; Allen, M. G., Physical Sciences, Inc., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 385-388; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Investigations of the dynamics of flame spread over combustible surfaces in microgravity are critical to spacecraft fire safety, as well as for the understanding of fundamental fire phenomena. In the absence of gravity-induced buoyancy and forced convection, heat transfer between the flame and the surface is dominated by conductive and radiative mechanisms. The detailed understanding of these mechanisms requires direct, quantitative observations of the spatial propagation and radiative fluxes of key flame product species such as CO2 and H2O. These observations can be performed non-intrusively in a microgravity combustion experiment by observing spatially and spectrally resolved infrared emission from the product molecular species. Additional flame species which can potentially be observed in this manner include CO, N2O, OH, NO, hydrocarbon vapor, and soot particles. The species-specific band structures of the molecular emissions enable discrimination between gas phase, particulate, and hot surface contributions to the observed emission. In addition, the observed band shapes and intensities can be analyzed quantitatively to determine species abundances, temperatures, and optical thickness effects. Such measurements are critically important for evaluating unsteady combustion models. We have recently initiated a research program to implement our previously developed Adaptive Infrared Imaging Spectrometer (AIRIS) instrument concept for high-speed, wavelength-tunable, and quantitative spatial imaging of mid-infrared (2 to 5 micron) flame and fuel surface emission in microgravity combustion experiments. AIRIS is a compact, wavelength-scanning spectral imager based on the use of a low-order Fabry-Perot interferometer coupled to an infrared detector array. We plan a four-year project to (1) demonstrate and optimize the AIRIS prototype instrument and quantitative infrared spectroscopic methods for normal-gravity laboratory flames, (2) design the integration of AIRIS with planned reduced-gravity experiments on unsteady flame propagation, and (3) conduct reduced-gravity flight tests using the prototype AIRIS filter. In this effort, we will collaborate closely with the SIBAL (Solid Inflammability Boundary at Low Speed) research team at NASA/ Glenn and Case Western Reserve University.

Derived from text

Infrared Imagery; Infrared Spectroscopy; Flame Propagation; Imaging Techniques; Convective Heat Transfer; Adaptive Filters; Fuel Combustion

19990054063 California Univ., Berkeley, CA USA

Numerical Study of Buoyancy and Differential Diffusion Effects on the Structure and Dynamics of Triple Flames

Chen, J. -Y., California Univ., USA; Echekki, T., Sandia National Labs., USA; Fifth International Microgravity Combustion

Workshop; May 1999, pp. 427-430; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Triple flames arise in a number of practical configurations where fuel and oxidizer are partially premixed, such as in the base of a lifted jet flame. Past experimental studies, theoretical analyses, and numerical modeling of triple flames suggested the potential role of triple flames in stabilizing turbulent flames and in promoting flame propagation. From recent numerical simulations of laminar triple flames, a strong influence of differential diffusion among species and heat on the triple flame structure has been gradually appreciated. This paper reports preliminary numerical results on the influence of gravity and differential diffusion effects on the structure and dynamics of triple flames with a one-step global irreversible chemistry model.
Derived from text

Mathematical Models; Direct Numerical Simulation; Buoyancy; Turbulent Flames; Laminar Flow; Gaseous Diffusion; Fuel Combustion; Flame Propagation

19990054067 Dayton Univ. Research Inst., OH USA

Reaction Kernel Structure and Diffusion Flame Stabilization

Takahashi, Fumiaki, Dayton Univ. Research Inst., USA; Nayagam, Vedha, National Center for Microgravity Research on Fluids and Combustion, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 441-444; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The attachment of a diffusion flame to solid or liquid surfaces is of fundamental and practical importance because of its relation to flame holding by bodies in combustion chambers and fire spread through condensed fuels for both terrestrial and space applications. Although simple diffusion flames formed in a gaseous fuel jet or over a flat fuel surface in a parallel oxidizing stream have long been studied as model combustor flames and fires, a flame-holding, or standing, mechanism has not been fully understood. The objectives of this research are to reveal the structure of the flame stabilizing region (flame base) of laminar two-dimensional (2D) jet diffusion flames and steady-state flat-plate burner flames in microgravity and to develop a unified flame stabilization mechanism common to these flames. The roles of inhibitors, particle dynamics, and boundary layer structure in flame stabilization will also be addressed during the project.
Derived from text

Diffusion Flames; Flame Holders; Flame Stability; Flat Plates; Burners; Jet Flow; Microgravity; Fuel Combustion

19990054068 Texas Univ., Dept. of Aerospace Engineering and Engineering Mechanics, Austin, TX USA

Investigation of Strain/Vorticity and Large-Scale Flow Structure in Turbulent Nonpremixed Jet Flames

Clemens, N. T., Texas Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 447-450; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Our study will use the microgravity environment to investigate the underlying flow structure of turbulent nonpremixed round jet flames. In particular, we aim to investigate the large-scale turbulent structure using planar laser Mie scattering (PLMS), and the strain rate and vorticity fields using particle image velocimetry (PIV). This work is motivated by recent studies in our laboratory that have led to several interesting observations of nominally momentum-driven turbulent nonpremixed planar flames. First of all, the organized large-scale turbulent structures that are observed in nonreacting planar jets may be substantially modified or suppressed in nonpremixed planar jet flames. Furthermore, a recent study using PIV and planar laser-induced fluorescence of OH has shown that in transitional and turbulent nonpremixed planar jet flames the presence of the flame seems to greatly influence the underlying vorticity and strain fields, as compared to nonreacting jets. For example, the reaction zones in the jet flames are strongly correlated with regions of high vorticity. A related study has demonstrated that vorticity is not correlated in the same way with either iso-scalar surfaces or scalar dissipation layers in nonreacting planar jets. Furthermore, the relationship between strain and the reaction zone appears to be modified by the presence of high levels of heat release. In particular, the strain rate field in planar jet flames exhibits a preferred direction of principal compressive strain that apparently is related to strong shear across the reaction zone. This preferred direction of strain was not observed in nonreacting jets. One of the major problems encountered when conducting these types of studies is that it is difficult to know to what extent buoyancy influences the results. Therefore, the microgravity environment provides us with an excellent opportunity to explore these issues without the complicating effects of buoyancy. This is particularly the case when studying flames that are transitional between laminar and turbulent states. For example, the strong correlation of vorticity with the reaction zone (discussed above) was observed in both transitional and turbulent planar flames, but the effect was stronger for the transitional case. to date, the reason for the presence of the vorticity-reaction zone correlation is not known, although vorticity production via baroclinic torque is a likely cause. The microgravity environment will

allow us to specifically determine whether the vorticity is produced by baroclinic torque resulting from the flame density gradient acting with the hydrostatic pressure gradient.AAdditional details of the planned experiments are provided.
Derived from text
Turbulent Flames; Strain Rate; Vorticity; Jet Flow; Hydrostatic Pressure; Microgravity; Turbulent Flow; Turbulent Jets

19990054071 NASA Glenn Research Center, Cleveland, OH USA
Dynamics of Droplet Extinction in Slow Convective Flows
Nayagam, V., National Center for Microgravity Research on Fluids and Combustion, USA; Haggard, J. B., Jr., NASA Glenn Research Center, USA; Williams, F. A., California Univ., San Diego, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 461-464; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The classical model for droplet combustion predicts that the square of the droplet diameter decreases linearly with time. It also predicts that a droplet of any size will burn to completion over a period of time. However, it has been known for some time that under certain conditions flames surrounding a droplet, in a quiescent environment, could extinguish because of insufficient residence time for the chemistry to proceed to completion. This type of extinction that occurs for smaller droplets has been studied extensively in the past. Large droplets, on the other hand, exhibit a different type of extinction where excessive radiative heat loss from the flame zone leads to extinction. This mode of ”radiative extinction” was theoretically predicted for droplet burning by Chao et al. and was observed in recent space experiments in a quiescent environment. Thus far, the fundamental flammability limit prescribed by radiative extinction of liquid droplets has been measured only under quiescent environmental conditions. In many space platforms, however, ventilation systems produce small convective flows and understanding of the influences of this convection on the extinction process will help better define the radiative extinction flammability boundaries. Boundaries defined by experiments and captured using theoretical models could provide enhanced fire safety margin in space explor1999063d investigation of convective effects will help in interpretations of burning-rate data obtained during free-floated droplet combustion experiments with small residual velocities.
Derived from text
Convective Flow; Drop Size; Drops (Liquids); Extinction; Extinguishing; Radiative Heat Transfer; Combustion Physics

19990054072 Yale Univ., Center for Combustion Studies, New Haven, CT USA
Combustion of Individual Bubbles and Submerged Gas Jets in Liquid Fuels
Rosner, Daniel E., Yale Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 465-468; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Motivated by industrial ”submerged flame” reactor experience, in which oxygen gas jets were ignited in liquid crude oil to synthesize acetylene and ethylene, we propose a sequence of fundamental microgravity and ground-based experiments, as well as ancillary theoretical studies, on the combustion of oxygen(-containing) bubbles in liquid fuels --- especially transparent liquid hydrocarbons. We demonstrate below that the detailed study of the combustion of large spherical bubbles is best carried out in a microgravity environment and that useful single-bubble data can probably be obtained in existing drop-tower facilities. The broad objectives of this new research program may be summarized as follows: (1) to exploit the microgravity environment and modern analytical/numerical/experimental techniques to carefully study a rather unexplored mode of liquid fuel combustion ---- ie., the transient combustion of an isolated spherical gaseous oxidizer bubble; (2) to use microgravity-derived insights, ancillary theoretical/numerical studies and new ground-based laboratory studies of combustion in bubble columns and submerged jets to provide a more rational basis to ultimately design improved ”submerged gas jet combustors” for use in ground-based synthesis-oriented chemical industry, especially when the liquid ”fuel” (feedstock) is difficult to ”atomize” (because of its viscosity or ”chemical aggressiveness”); and (3) to open up a relatively virgin branch of bubble dynamics dealing with intra-bubble chemical reactions. This can be later extended to more complex systems such as oxidizer bubbles in more energetic fuels (such as hydrazine or molten aluminum), or, conversely, fuel vapor pockets in non-cryogenic and cryogenic liquid oxidizers. Ironically, fundamental studies of this neglected branch of combustion should, as byproducts, shed valuable new light on many apparently different modes of combustion or bubble-contacting devices including, perhaps, the combustion of foams containing air.
Derived from text
Bubbles; Fuel Combustion; Gas Jets; Liquid Fuels; Liquid Oxidizers; Microgravity; Hydrocarbon Combustion; Combustion Chemistry

19990054075 National Inst. of Standards and Technology, Building and Fire Research Lab., Gaithersburg, MD USA
Carbon Monoxide and Soot Formation in Inverse Diffusion Flames
Blevins, L. G., National Inst. of Standards and Technology, USA; Mulholland, G. W., National Inst. of Standards and Technology, USA; Davis, R. W., National Inst. of Standards and Technology, USA; Fifth International Microgravity Combustion Workshop;

May 1999, pp. 479-482; In English; See also 19990053965
Contract(s)/Grant(s): NASA Order C-32069-J; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The objective of this project is to study carbon monoxide (CO) and soot formation in laminar, inverse diffusion flames (IDFs). The IDF is used because it is a special case of underventilated combustion. The microgravity environment is crucial for this study because buoyancy-induced instabilities impede systematic variation of IDF operating conditions in normal gravity. The project described in this paper is just beginning, and no results are available. Hence, the goals of this paper are to establish the motivation for the research, to review the IDF literature, and to briefly introduce the experimental and computational plan for the research. Derived from text

Buoyancy; Carbon Monoxide; Diffusion Flames; Microgravity; Soot

19990054076 Michigan Univ., Dept. of Aerospace Engineering, Ann Arbor, MI USA

Flow/Soot-Formation Interactions in Nonbuoyant Laminar Diffusion Flames

Dai, Z., Michigan Univ., USA; Faeth, G. M., Michigan Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 483-486; In English; See also 19990053965
Contract(s)/Grant(s): NCC3-661; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Nonpremixed (diffusion) flames are attractive for practical applications because they avoid the stability, autoignition, flashback, etc. problems of premixed flames. Unfortunately, soot formation in practical hydrocarbon-fueled diffusion flames reduces their attractiveness due to widely-recognized public health and combustor durability problems of soot emissions. For example, more deaths are attributed to the emission of soot (15,000-60,000 deaths annually in the U.S. alone) than any other combustion-generated pollutant. In addition, continuum radiation from soot-containing flames is the principle heat load to combustor components and is mainly responsible for engine durability problems of aircraft and gas turbine engines. As a result, there is considerable interest in controlling both soot concentrations within flames and soot emissions from flames. Thus, the objective of the present investigation is to study ways to control soot formation in diffusion flames by manipulating the mixing process between the fuel and oxidant streams. In order to prevent the intrusion of gravity from masking flow properties that reduce soot formation in practical flames (where effects of gravity are small), methods developed during past work will be exploited to minimize effects of buoyant motion. Derived from text

Buoyancy; Diffusion Flames; Soot; Fuel Combustion; Hydrocarbon Combustion; Flow Velocity

19990054077 California Univ., Dept. of Mechanical and Aeronautical Engineering, Davis, CA USA

The Impact of Buoyancy and Flame Structure on Soot, Radiation and NOx Emissions from a Turbulent Diffusion Flame

Kennedy, I. M., California Univ., USA; Kollman, W., California Univ., USA; VanderWal, R. L., National Center for Microgravity Research on Fluids and Combustion, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 487-490; In English; See also 19990053965
Contract(s)/Grant(s): NCC3-544; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

It is hypothesized that the spatial structure of a turbulent diffusion flame plays an important role in determining the emissions of radiative energy, soot and NO, from a combustor. This structure, manifested in the two point statistics, is influenced by buoyancy. Radiation, soot and NOx emissions are the cumulative result of processes that occur throughout a flame. For example, radiation fluxes along a line of sight can be found from summing up the contributions from sources in individual pockets of hot soot that emit, and from sinks in cold soot that absorb. Soot and NOx are both the results of slow chemistry and are not equilibrium products. The time that is available for production and burnout is crucial in determining the eventual emissions of these pollutants. Turbulence models generally rely on a single point closure of the appropriate time averaged equations. Hence, spatial information is lost and needs to be modeled using solution variables such as turbulence kinetic energy and dissipation rate, often with the assumption of isotropy. However, buoyancy can affect the physical structure of turbulent flames and can change the spatial extent of soot bearing regions. Theoretical comparisons with models are best done in the limit of infinite Froude number because the inclusion of buoyancy in flow models introduces significant uncertainties. Hence, LII measurements of soot, measurements of radiation fluxes from soot, Particle Imaging Velocimetry (PIV) of the flow field and measurements of post flame NOX will be carried out on the NASA Lewis 2.2 sec drop tower and eventually on the parabolic flight aircraft. The drop rig will be a modified version of a unit that has been successfully used at Lewis in the past. Derived from text

Buoyancy; Flame Stability; Diffusion Flames; Turbulent Flames; Soot; Radiation Transport; Exhaust Emission; Mathematical Models; Combustion Products

19990054078 National Inst. of Standards and Technology, Gaithersburg, MD USA

Kinetics and Structure of Superagglomerates Produced by Silane and Acetylene

Mulholland, G. W., National Inst. of Standards and Technology, USA; Hamins, A., National Inst. of Standards and Technology, USA; Sivathanu, Y., En'Urga, Inc., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 491-494; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The evolution of smoke in a laminar diffusion flame involves several steps. The first step is particle inception/nucleation in the high-temperature fuel-rich region of the flame followed by surface growth and coagulation/coalescence of the small particles. As the primary spheres grow in size and lose hydrogen, the colliding particles no longer coalesce but retain their identity as a cluster of primary spheres, termed an agglomerate. Finally, in the upper portion of the flame, the particles enter an oxidizing environment which may lead to partial or complete burnout of the agglomerates. Currently there is no quantitative model for describing the growth of smoke agglomerates up to superagglomerates with an overall dimension of 10 microns and greater. Such particles are produced during the burning of acetylene and fuels containing benzene rings such as toluene and polystyrene. In the case of polystyrene, smoke agglomerates in excess of 1 mm have been observed "raining" out from large fires. Evidence of the formation of superagglomerates in a laminar acetylene/air diffusion flame has been recently reported. Acetylene was chosen as the fuel since the particulate loading in acetylene/air diffusion flames is very high. Photographs were obtained by Sorensen using a microsecond xenon lamp of the "stream" of soot just above the flame. For low flow rates of acetylene, only submicrometer soot clusters are produced and they give rise to the homogeneous appearance of the soot stream. When the flow rate is increased to 1.7 cu cm/s, soot clusters up to 10 microns are formed and they are responsible for the graininess and at a flow rate of 3.4 cu cm/s, a web of interconnected clusters as large as the width of the flame is seen. This interconnecting web of superagglomerates is described as a gel state by Sorensen et al (1998). This is the first observation of a gel for a gas phase system. It was observed that this gel state immediately breaks up into agglomerates due to buoyancy induced turbulence and gravitational sedimentation.

Derived from text

Agglomeration; Diffusion Flames; Combustion Products; Hydrocarbon Combustion; Smoke; Kinetics; Laminar Flow; Gelation; Soot

19990054079 Titan Corp., AeroChem Research Lab., Princeton, NJ USA

Internal Heterogeneous Processes in Aluminum Combustion

Dreizin, E. L., Titan Corp., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 497-500; In English; See also 19990053965

Contract(s)/Grant(s): NAS3-27259; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

This paper discusses the aluminum particle combustion mechanism which has been expanded by inclusion of gas dissolution processes and ensuing internal phase transformations. This mechanism is proposed based on recent normal and microgravity experiments with particles formed and ignited in a pulsed micro-arc. Recent experimental findings on the three stages observed in Al particle combustion in air and shows the burning particle radiation, trajectory (streak), smoke cloud shapes, and quenched particle interiors are summarized. During stage I, the radiation trace is smooth and the particle flame is spherically symmetric. The temperature measured using a three-color pyrometer is close to 3000 K. Because it exceeds the aluminum boiling point (2730 K), this temperature most likely characterizes the vapor phase flame zone rather than the aluminum surface. The dissolved oxygen content within particles quenched during stage I was below the detection sensitivity (about 1 atomic %) for Wavelength Dispersive Spectroscopy (WDS). After an increase in the radiation intensity (and simultaneous decrease in the measured color temperature from about 3000 to 2800 K) indicative of the transition to stage II combustion, the internal compositions of the quenched particles change. Both oxygen-rich (approx. 10 atomic %) and oxygen-lean (is less than 1 %) regions are identified within the particles using back-scattered electron imaging and WDS. During stage II, oscillations are observed in particle radiation and the flame and smoke cloud are distorted from their original spherically-symmetric shape. In stage III, particle radiation continues to exhibit oscillations, but its radiation intensity drops and remains at a nearly constant level. The measured temperature decreases to about 2300 K. Also, larger changes in particle velocities are observed, and oxide caps are found on quenched particle surfaces. While these results showed the correlation between the aluminum particle combustion behavior and the evolution of its internal composition, the change from the spherically symmetric to asymmetric flame shape occurring upon the transition from stage I to stage II combustion could not be understood based only on the fact that dissolved oxygen is detected in the particles. The connection between the two phenomena appeared even less significant because in earlier aluminum combustion studies carried in O2/Ar mixtures, flame asymmetry was not observed as opposed to experiments in air or O2/CO mixtures. It has been proposed that the presence of other gases, i.e., hydrogen, or nitrogen causes the change in the combustion regime.

Derived from text

Aluminum; Metal Combustion; Metal Particles; Particle Trajectories; Phase Transformations

19990054080 NASA Glenn Research Center, Cleveland, OH USA

Interferometer Development for Study of Interactions between Flames on Parallel Solid Surfaces

Goldmeer, J. S., National Academy of Sciences - National Research Council, USA; Urban, D. L., NASA Glenn Research Center, USA; Yuan, Z. G., National Center for Microgravity Research on Fluids and Combustion, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 501-504; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The interactions between flames spreading over parallel solid sheets of paper are being studied in normal gravity and in microgravity. This geometry provides interesting opportunities to study the interaction of radiative and diffusive transport mechanisms on the spread process. These transport mechanisms are changed when the flame interacts with other flames. Most practical heterogeneous combustion processes involve interacting discrete burning fuel elements, consequently, the study of these interactions is of practical significance. Owing largely to this practical importance, flame interactions have been an area of active research, however microgravity research has been largely limited to droplets. Consideration of flame spread over parallel solid surfaces has been limited to 1-g studies. to study the conductive transport in these flames, an interferometer system has been developed for use in the drop tower. The system takes advantage of a single beam interferometer: Point Diffraction Interferometry (PDI) which uses a portion of the light through the test section to provide the reference beam. Like other interferometric and Schlieren systems, it is a line of sight measurement and is subject to the usual edge and concentration effects. The advantage over Schlieren and shearing interferometry systems is that the fringes are lines of constant index of refraction rather than of its gradient so the images are more readily interpreted. The disadvantage is that it is less able to accommodate a range of temperature gradients.
Derived from text

Flame Propagation; Chemical Reactions; Combustion Physics; Interferometers; Solid Surfaces

19990054081 NASA Glenn Research Center, Cleveland, OH USA

Low Stretch Diffusion Flames Over a Solid Fuel

Olson, S. L., NASA Glenn Research Center, USA; T'ien, J. S., Case Western Reserve Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 505--508; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

A unique new way to study low gravity flames in normal gravity has been developed. to study flame structure and extinction characteristics in low stretch environments, a normal gravity low-stretch diffusion flame is generated using a cylindrical PMMA sample of varying large radii. Foutch and T'ien used the radiative loss as well as a densimetric Froude number to characterize the blowoff (small Da) and quenching extinction (large Da) boundaries in stagnation-point diffusion flames under various convective conditions. An important conclusion of this study was that the shape and location of the extinction boundary, as well as a number of important flame characteristics, were almost identical for the buoyant, forced, and mixed convective environments they modeled. This theory indicates it should be possible to understand a material's burning characteristics in the low stretch environment of spacecraft (induced by fans and crew movements) by understanding its burning characteristics in an equivalent Earth-based stretch environment (induced by normal gravity buoyancy). Similarly, the material's burning characteristics in Lunar or Martian stretch environments (induced by partial gravity buoyancy) can be assessed. Equivalent stretch rates can be determined as a function of gravity, imposed flow, and geometry. A generalized expression for stretch rate which captures mixed convection includes both buoyant and forced stretch is defined as a = a(sub f) ((1 + (a(sub b))exp 2/(a(sub b))exp 2))exp 1/2. For purely buoyant flow, the equivalent stretch rate is a(sub b) = [(rho(exp e)-rho(exp *)/rho(sub e)][g/R](exp 1/2). For purely forced flow, the equivalent stretch rate is characterized by either a(sub f)= 2U(sub infinity)/R for a cylinder, or a(sub f)=U(sub jet)/d(sub jet) for a jet impinging on a planar surface. In these experiments, the buoyant stretch is varied through R, the radius of curvature, but the buoyant stretch could also be varied through g, the gravity level. In this way the effect of partial gravity, such as those found on the Moon (1/6 g) or Mars (1/3 g) can be captured in the definition of flame stretch.
Author

Diffusion Flames; Solid Propellant Combustion; Fuel Combustion; Stretching

19990054084 National Inst. of Standards and Technology, Gaithersburg, MD USA

Simulation of Combustion Systems with Realistic g-Jitter

Mell, William E., National Inst. of Standards and Technology, USA; McGrattan, Kevin B., National Inst. of Standards and Technology, USA; Baum, Howard R., National Inst. of Standards and Technology, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 519-522; In English; See also 19990053965
Contract(s)/Grant(s): NASA Order C-32070-J; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

A number of facilities are available for microgravity combustion experiments: aircraft, drop tower, sounding rocket, space shuttle and, in the future, the international space station (ISS). Acceleration disturbances or g-jitter about the background level

of reduced gravity exist in all the microgravity facilities. While g-jitter is routinely measured, a quantitative comparison of the quality of g-jitter among the different microgravity facilities has not been compiled. Low frequency g-jitter (is less than 1 Hz) has been repeatedly observed to disturb a number of combustion systems. Guidelines regarding tolerable levels of acceleration disturbances for a given combustion system have been developed for use in the design of ISS experiments. The validity of these guidelines, however, remains unknown. In this project, recently funded by NASA, a transient, fully three-dimensional simulation code will be developed to simulate the effects of realistic g-jitter on a number of combustion systems. Acceleration disturbances of realistic orientation, magnitude and time dependence will be included in the simulation. Since this is a newly funded project with code development just under-way no simulation results will be presented. Instead, first a short review of the relevant background concerning g-jitter will be given followed by a section on the proposed technical approach.
Derived from text
Computerized Simulation; Microgravity; Three Dimensional Models; Combustion Stability; Combustion Physics; Vibration Effects

19990054172 Department of the Navy, Washington, DC USA
Compounds Labeled with Cyanate or Thiocyanate Metal Complexes for Detection by Infrared Spectroscopy
Conrad, David W., Inventor; Patterson, Charles H., Inventor; Oct. 20, 1998; 6p; In English; Supersedes US-Patent-Appl-SN-940736, AD-D018797.
Patent Info.: Filed 30 Sep. 97,; US-Patent-Appl-SN-940,736; US-Patent-5,824,803
Report No.(s): AD-D019329; No Copyright; Avail: US Patent and Trademark Office, Microfiche
The invention pertains to a labeled compound detectable by IR spectroscopy contains at least one histidine residue bound to a cyanate or thiocyanate metal complex that has an IR absorption band within the spectral region of 2399-1900/cm. An assay reagent for simultaneously detecting or determining a plurality of different analytes in a sample is made up of a plurality of different labeled compounds, each being independently distinguishable from the others by absorbing energy in a different and distinguishable region in the range of 2300 to 1900/cm.
DTIC
Infrared Spectroscopy; Cyanates; Infrared Absorption; Complex Compounds

19990054447 Wiss, Janney, Elstner and Associates, Inc., Northbrook, IL USA
Corrosion Evaluation of Epoxy-Coated, Metallic-Clad and Solid Metallic Reinforcing Bars in Concrete ***Final Report, 1993 - 1998***
McDonald, D. B.; Pfeifer, D. W.; Sherman, M. R.; Dec. 1998; 144p; In English
Report No.(s): PB99-146722; Publication FHWA-RD-98-153; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
This report describes the work conducted from 1993 to 1998 to develop cost-effective 'new breeds' of organic, inorganic, ceramic and metallic coatings, as well as metallic alloys that can be utilized on or as reinforcement for embedment in portland cement concrete. As part of the study, 12 different bar types were tested in concrete: black bars, 3 bendable and 3 nondendable epoxies, Type 304 and Type 316 stainless steel, copper-clad, galvanized and spray metallic-clad reinforcing. Measurements of macrocell voltages, half-cell potentials, electrical impedance spectroscopy, linear polarization and mat-to-mat resistances were used in conjunction with visual observations to determine the effectiveness of each system.
NTIS
Corrosion; Epoxy Resins; Metal Coatings; Cladding; Reinforcement (Structures); Concretes; Inorganic Coatings

19990054475 Centre National de la Recherche Scientifique, LASIR, Thiais, France
Vibrational spectroscopy
Fillaux, F., Centre National de la Recherche Scientifique, France; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 39-44; In English; See also 19990054467; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche
Vibrational spectroscopy is a frequently used technique in fundamental and applied research. Infrared and Raman instruments are routinely available in many laboratories and companies, whilst inelastic neutron scattering (INS) can only be carried out at a very limited number of neutron sources. Vibration frequencies depend on the chemical bonds linking atoms and the interactions between molecules. Intensities depend on interactions between the incident radiation and the sample. Although vibrational spectra are commonly used to finger-print molecular groups for analytical purposes or process-control, these spectra also contain important information on the vibrational dynamics which is still far from being fully understood. The purpose of fundamental research in this field is to achieve a realistic representation of vibrational dynamics. Theoretical approaches (e.g. quantum chemistry) are

not yet able to account precisely for the observations, and experimental vibrational spectra are still the only means to obtain detailed information.
Derived from text
Inelastic Scattering; Neutron Sources; Spectroscopy; Vibrational Spectra; Vibrational States; Neutron Scattering; Single Crystals

19990054580 Alabama Univ., Research Inst., Huntsville, AL USA
Chalcopyrite Materials Model--CM2 (Electronic Structure and Transport Properties), *15 Jul. 1996 - 14 Oct. 1998*
Madarasz, Frank L., Alabama Univ., USA; Dec. 04, 1998; 9p; In English
Contract(s)/Grant(s): F49620-96-1-0318
Report No.(s): AD-A363640; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Electronic transport measurements are a method of obtaining quantitative data about a semiconductor material. The measurement of the conductivity and Hall mobilities and the subsequent analysis can determine the important processes limiting the materials usefulness. For the case of Cadmium Germanium Diarsenide (CGA), saturation at higher pump power in laser systems limits its usefulness as an optical parametric oscillator (OPO) and frequency doubler. The observed saturation has been attributed to inter- and intra-valence band transitions. The intent of the this program was to verify these saturation mechanisms using an appropriate model of CGA valence band structure and electronic transport properties to predict related optional absorption and saturation. Modeling the transport properties of CGA should help in an understanding of the mechanisms behind this saturation. In addition, it will assist in materials improvement programs to reduce or eliminate the process(es) resulting in the observed saturation to obtain high conversion efficiencies observed at short wavelength infrared to LWIR CO2 region. The ultimate goal will be a greater than 25% conversion efficiency with high power CO2 pumps.
DTIC
Composite Materials; Semiconductors (Materials); Laser Pumping; Electronic Structure; Transport Properties

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METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

19990053783 Lawrence Livermore National Lab., Livermore, CA USA
Decarburication of Uranium Via Electron Beam Processing
McKoon, R. H., Lawrence Livermore National Lab., USA; Oct. 23, 1998; 10p; In English; Electron Beam Melting and Refining State of the Art 1998, 18-20 Oct. 1998, Reno, NV, USA
Contract(s)/Grant(s): W-7405-ENG-48
Report No.(s): AD-A362955; UCRL-JC-131866; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

For many commercial and military applications, the successive Vacuum Induction Melting of uranium metal in graphite crucibles results in a product which is out of specification in carbon. The current recovery method involves dissolution of the metal in acid and chemical purification. This is both expensive and generates mixed waste. A study was undertaken at Lawrence Livermore National Laboratory to investigate the feasibility of reducing the carbon content of uranium metal using electron beam techniques. Results will be presented on the rate and extent of carbon removal as a function of various operating parameters.
DTIC
Electron Beams; Vacuum Melting; Induction Heating

19990053790 National Inst. of Standards and Technology, Materials Science and Engineering Lab., Gaithersburg, MD USA
Corrosion Fatigue Crack Initiation in Duplex Stainless Steel Paper Making Components *Final Report*
Stoudt, M. R.; Mar. 1999; 96p; In English
Report No.(s): PB99-131930; NISTIR-6309; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The demand for more cost-effective paper production has generated a strong driving force for wider and faster paper machines. As a result, the reliability and durability of the metallic components in those machines have become pivotal issues and as such, increased the awareness of the enormous economic impact associated with equipment repair and replacement throughout the pulp and paper industry. A good example of this problem has been reported by Sandusky International, the sole US based producer of suction roll shells for the paper industry. This company produces two duplex stainless steel alloys with very similar compositions and the performance predictions based on laboratory measurements and current life prediction methods indicate that the behaviors of these two alloys should be virtually identical in service. However, in the ten year period since the development

of these alloys, Sandusky has not experienced a single service failure with one alloy while the other alloy continues to fail prematurely. This research was primarily designed to develop a solution to the problem as reported by Sandusky International. Simply stated, that problem is: in-service Alloy 75 corrosion fatigue failures occur even though the life prediction methods indicate they should not. The existing measurement methods and interpretations indicate that both Alloy 75 and Alloy 86 should have essentially identical corrosion fatigue behaviors, yet one alloy fails in service while the other does not.
NTIS
Corrosion; Fatigue (Materials); Cracking (Fracturing); Fractures (Materials); Crack Propagation; Crack Initiation; Metal Fatigue

19990053801 Army Test and Evaluation Command, Aberdeen Proving Ground, MD USA
Chemical Compatibility of Nonmetallic Materials Used in Small Arms Systems
Feb. 12, 1999; 20p; In English
Report No.(s): AD-A359425; TOP-3-2-609; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This TOP provides procedures for evaluating the chemical compatibility of nonmetallis materials used in small arms systems (weapons/ammunition) by conditioning them in various chemical solutions. Physical properties of the material to be tested are measured before and after conditioning to determine the degradation attributable to the chemical solution. The chemicals used for the test are mainly used in military training, maintenance, and combat environments.
DTIC
Chemical Compatibility; Physical Properties; Weapon Systems

19990053903 Department of the Navy, Washington, DC USA
Method of Making Chemically Engineered Metastable Alloys and Multiple Components Nanoparticles
Edelstein, Alan S., Inventor; Harris, Vincent G., Inventor; Nov. 10, 1998; 9p; In English; Supersedes US-Patent-Appl-SN-672772
Patent Info.: Filed 28 Jun. 96,; US-Patent-Appl-SN-672,772; US-Patent-5,834,057
Report No.(s): AD-D019328; No Copyright; Avail: US Patent and Trademark Office, Microfiche
Nanoparticles of a mixed oxide precursor are reduced to form particles of a nanostructured metastable alloy having a majority metal and a minority metal. Additional heating enriches the surfaces of the particles with respect to the minority metal, thus forming a coating on the particle core. This coating has a higher atomic ratio of minority to majority metal than found in the precursor. The nanostructured metastable alloys may then be oxidized to form nanoparticles having a coating of the oxide of the minority metal and a core of the majority metal or an oxide of the majority metal. The majority metal may be, for example, copper. The minority metal may be, for example, cobalt.
DTIC
Metastable State; Metal Coatings; Heating; Cobalt

19990054061 NASA Glenn Research Center, Cleveland, OH USA
Synthesis of Graphite Encapsulated Metal Nanoparticles and Metal Catalyzed Nanotubes
vanderWal, R. L., NASA Glenn Research Center, USA; Dravid, V. P., Northwestern Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 417-420; In English; See also 19990053965
Contract(s)/Grant(s): NCC3-544; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche
This work focuses on the growth and inception of graphite encapsulated metal nanoparticles and metal catalyzed nanotubes using combustion chemistry. Deciphering the inception and growth mechanism(s) for these unique nanostructures is essential for purposeful synthesis. Detailed knowledge of these mechanism(s) may yield insights into alternative synthesis pathways or provide data on unfavorable conditions. Production of these materials is highly desirable given many promising technological applications.
Derived from text
Synthesis (Chemistry); Combustion Chemistry; Nanostructure (Characteristics)

19990054332 Department of the Navy, Washington, DC USA
Process for Making Superplastic Steel Powder and Flakes
Ayers, Jack D., Inventor; Dec. 01, 1998; 5p; In English; Supersedes , AD-D015183
Patent Info.: US-Patent-Appl-SN-621,922; US-Patent-5,843,245
Report No.(s): AD-D019294; No Copyright; Avail: US Patent and Trademark Office, Microfiche
In a process for making superplastic steel powder or flakes, molten steel is rapidly solidified to form a solidified material comprising substantially single-phase austenitic steel powder or flakes having a grain size of no greater than about 2 micrometers.

The powder or flakes are heated at a temperature of 300 deg C. to 600 deg C. to produce superplastic steel comprising a mixture of ferrite steel and at least one metal carbide, the ferrite steel having a randomly oriented structure and having a train size of no greater than about 2 micrometers, the at least one metal carbide having a grain size no greater than about 0.5 micrometers. The steel powder or flake is then recovered for further processing. A consolidated superplastic steel can be formed from the powder or flake by hot pressing the powder or flake at a temperature of between about 650 deg C. and about 950 deg C. and at a pressure of about 10 MPa to about 100 MPa for a time sufficient to form a fully dense consolidate
DTIC
Superplasticity; Powder (Particles); Austenitic Stainless Steels; Metal Powder; Ferrites

19990054521 Army Research Development and Standardization Group (UK), (united Kingdom) FPO New York 09510, FPO New York, NY USA
Edge Effects at Spall Fracture for Titanium Alloys of Varying Oxygen Content ***Final Report, 18 Sep. 1997 - 1 Jul. 1998***
Razorenov, Sergey V.; Kanel, Gennadii I.; Utkin, Alexander V.; Sep. 01, 1998; 33p; In English
Contract(s)/Grant(s): N68171-97-M-5772
Report No.(s): AD-A359490; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The samples of as-received Ti-6%A1-4%V alloys of 3 different oxygen contents ranging from 0.1% to 0.24% have been tested in about 50 shock-wave experiments. In the experiments performed the Hugoniot elastic limit, the spall strength, and the critical diameter for the spall element separation were measured. The peak shock stress was varied from 4 to 75 GPa, the load duration from 10(exp -7) s to 10(exp -5) s. The VISAR free-surface velocity measurements show a growth by 20% in the Hugoniot elastic limit of alloys with increasing the oxygen content from 0.105 up to 0.24%. The measurements have not revealed a notable variations in the spall strength magnitudes as a function of the oxygen content. The spall strength grows by 10 to 20% when the load duration decreases by an order of magnitude. The peak stress in shock wave preceding to spall fracture does not influence the spall strength value. The computer simulation of spall experiments was performed with the 1-D Lagrangian code. The description of the elastic-plastic properties is based on the structural Marzing model. Fracture was calculated using the empirical constitutive relationship which provides quite reasonable description of the spall process.
DTIC
Titanium Alloys; Vanadium Alloys; Oxygen; Computerized Simulation; Aluminum Alloys; Fracturing

19990054597 Shanghai Jiao Tong Univ., Open Lab. of Education Ministry for High-Temperature Materials and Tests, China
Brittle-to-Ductile Transition Temperature and its Controlling Mechanism in Ti-47Al-2Mn-2Nb Alloy
Lin, Dong-Liang, Shanghai Jiao Tong Univ., China; Wang, Yu, Shanghai Jiao Tong Univ., China; Liu, Jun-Liang, Shanghai Jiao Tong Univ., China; Law, Chi C., Pratt and Whitney Aircraft, USA; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 55-60; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Brittle-to-ductile transition (BDT) temperature (T(sub BD)) has been evaluated according to temperature dependence of tensile properties under different strain rates from 10(exp -5) to 10(exp -1)/s in a two-phase Ti-47Al-2Mn-2Nb alloy with near lamellar microstructure. Tensile fractography was observed using a scanning electron microscope while deformation substructures were investigated using a transmission electron microscope. It was found that T(sub BD), when defined as the temperature corresponding to 7.5% elongation, increases from 1023K to more than 1373K, the strain rate increases from 10(exp -5) to 10(exp -1)/s. Based on the strain rate dependence of T(sub BD) (and using the Zener-Hollomon factor) an apparent activation energy of 324kJ/mol was obtained, which is approximate to the self- and inter-diffusion activation energies in the gamma-TiAl phase. Transgranular fracture and dimple fracture were found to dominate in fracture surfaces below and above T(sub BD), respectively. Furthermore, the most popular 1/2is less than 110] ordinary dislocations were found to begin to climb around T(sub BD). All this evidence, as well as a theoretical calculation using the Nabarro Model, add up to a conclusion that the BDT of the alloy is controlled by dislocation climbing.
Author
Ductile-Brittle Transition; Transition Temperature; Phase Transformations; Brittleness; Ductility; Fracture Strength; Fractography; Titanium Aluminides; Titanium Alloys; Aluminum Alloys

19990054598 National Taiwan Univ., Inst. of Materials Science and Engineering, Taipei, Taiwan, Province of China
Hydrogen Trapping Ability of Steels with Different Microstructures
Chan, Sammy Lap Ip, National Taiwan Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 43-53; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects of microstructure on the hydrogen trapping ability and effective diffusivity in steels with different carbon content have been studied. The sites for trapping hydrogen in pure iron, ferrite/pearlite steel, and the martensitic structure etc. have been identified. The hydrogen pick-up was generally increased with the amount of grain boundary area in the steel. The hydrogen content of a steel after hydrogen charging increases and its hydrogen apparent diffusivity decreases, with a lowering of the transformation temperature. Thus a fully martensitic structure occludes the largest amount of hydrogen and possesses the lowest hydrogen apparent diffusivity. This microstructure retains a large portion of hydrogen even after high temperature outgassing. However, the hydrogen content reduces when the martensitic structure is tempered before charging. The effect of carbon content of the steel on the hydrogen occlusivity will also be discussed.
Author
Hydrogen; Trapping; Diffusivity; Steels

19990054599 West Virginia Univ., Morgantown, WV USA
Cracking Control in DC Casting of High-Strength Aluminum Alloys
Chang, Keh-Minn, West Virginia Univ., USA; Kang, Bruce, West Virginia Univ., USA; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 27-42; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper summarizes research efforts at WVU, conducted to comprehensively understand the fundamental mechanism of solidification cracking of high-strength aluminum alloys for aerospace plate applications. Three important technical approaches were adapted: 1. in-situ thermal couples drop measurement of DC (direct chill) casting; 2. characterization of thermo-mechanical properties of cast ingots, correlated with the cast structure; 3. numerical modeling of ingot thermal/stress history. The alloy of interest was 7050. The research efforts focused on both the transient and steady stages of DC casting.
Author
Casting; Ingots; Solidification; High Strength Alloys; Aluminum Alloys; Cracking (Fracturing)

19990054608 UES, Inc., Materials and Processes Div., Dayton, OH USA
Advances in the Fundamental Understanding for Designing Engineering Gamma TiAl Alloys
Kim, Young-Won, UES, Inc., USA; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 13-25; In English
Contract(s)/Grant(s): F33615-91-C-5663; F33615-96-C-5258; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Phase transformations and microstructural evolution observed in various gamma-TiAl based alloys are discussed. The mechanical properties are summarized and analyzed in duplex as well as fully-lamellar materials over a wide range of grain sizes. From the structure-property relationships, a generalization is made on the desired microstructural features which will result in significant improvements in balanced or specific properties. Further property enhancement, especially in creep resistance achieved by microalloying with carbon and Si, is also discussed. On the basis of the accumulated knowledge and data, the next-generation TiAl alloy system for higher temperature use is formulated.
Author
Titanium Aluminides; Titanium Alloys; Aluminum Alloys; Alloying

19990054627 Oak Ridge National Lab., TN USA
Fracture assessment of HSST Plate 14 shallow-flaw cruciform bend specimens tested under biaxial loading conditions
Bass, B. R.; McAfee, W. J.; Williams, P. T.; Pennell, W. E.; Jun. 30, 1998; 89p; In English
Report No.(s): DE98-058123; ORNL/NRC/LTR-98/9; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A technology to determine shallow-flaw fracture toughness of reactor pressure vessel (RPV) steels is being developed for application to the safety assessment of RPVs containing postulated shallow surface flaws. Matrices of cruciform beam tests were developed to investigate and quantify the effects of temperature, biaxial loading, and specimen size on fracture initiation toughness of two-dimensional (constant depth), shallow, surface flaws. The cruciform beam specimens were developed at Oak Ridge National Laboratory (ORNL) to introduce a far-field, out-of-plane biaxial stress component in the test section that approximates the nonlinear stresses resulting from pressurized- thermal-shock or pressure-temperature loading of an RPV. Tests were conducted under biaxial load ratios ranging from uniaxial to equibiaxial. These tests demonstrated that biaxial loading can have a pronounced effect on shallow-flaw fracture toughness in the lower transition temperature region for an RPV material. The cruciform fracture toughness data were used to evaluate fracture methodologies for predicting the observed effects of biaxial loading on shallow-flaw fracture toughness. Initial emphasis was placed on assessment of stress- based methodologies, namely, the J-Q formulation, the Dodds-Anderson toughness scaling model, and the Weibull approach. Applications of these methodologies based on the

hydrostatic stress fracture criterion indicated an effect of loading-biaxiality on fracture toughness; the conventional maximum principal stress criterion indicated no effect. A three-parameter Weibull model based on the hydrostatic stress criterion is shown to correlate the experimentally observed biaxial effect on cleavage fracture toughness by providing a scaling mechanism between uniaxial and biaxial loading states.
NTIS
Pressure Vessels; Reactor Materials; Fracture Mechanics; Fracture Strength; Axial Loads; Steels

19990054628 Oak Ridge National Lab., TN USA
Grain growth behavior and high-temperature high-strain-rate tensile ductility of iridium alloy DOP-26
McKamey, C. G.; Gubbi, A. N.; Lin, Y.; Cohron, J. W.; Lee, E. H.; Apr. 30, 1998; 78p; In English
Report No.(s): DE98-058101; ORNL-6935; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report summarizes results of studies conducted to date under the Iridium Alloy Characterization and Development subtask of the Radioisotope Power System Materials Production and Technology Program to characterize the properties of the new-process iridium-based DOP-26 alloy used for the Cassini space mission. This alloy was developed at Oak Ridge National Laboratory (ORNL) in the early 1980's and is currently used by NASA for cladding and post-impact containment of the radioactive fuel in radioisotope thermoelectric generator (RTG) heat sources which provide electric power for interplanetary spacecraft. Included within this report are data generated on grain growth in vacuum or low- pressure oxygen environments; a comparison of grain growth in vacuum of the clad vent set cup material with sheet material; effect of grain size, test temperature, and oxygen exposure on high-temperature high-strain-rate tensile ductility; and grain growth in vacuum and high-temperature high-strain-rate tensile ductility of welded DOP-26. The data for the new-process material is compared to available old-process data.
NTIS
Iridium Alloys; Spacecraft Power Supplies; Thermoelectric Generators; Crystal Growth

19990054629 Westinghouse Savannah River Co., Aiken, SC USA
Silica Embedded Metal Hydrides
Heung, L. K.; Wicks, G. G.; Dec. 31, 1998; 11p; In English; International symposium on metal hydrogen systems - fundamentals and applications
Report No.(s): DE98-057956; WSRC-MS-98-00174; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A method to produce silica embedded metal hydride was developed. The product is a composite in which metal hydride particles are embedded in a matrix of silica. The silica matrix is highly porous. Hydrogen gas can easily reach the embedded metal hydride particles. The pores are small so that the metal hydride particles cannot leave the matrix. The porous matrix also protects the metal hydride particles from larger and reactive molecules such as oxygen, since the larger gas molecules cannot pass through the small pores easily. Tests show that granules of this composite can absorb hydrogen readily and withstand many cycles without making fines.
NTIS
Silicon Dioxide; Metal Hydrides

27
NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 Composite Materials.

19990053547 University of Electro-Communications, Dept. of Applied Physics and Chemistry, Tokyo, Japan
Observations of Grain and Ferroelectric Domain of Hot-Pressed Pb(1 - x)La(x)(Zr(y)Ti(1 - y)(1 - x/4)O3 Ceramics using a Transmission Electron Microscope
Mitsuhashi, Hideto, University of Electro-Communications, Japan; Koyama, Shoji, University of Electro-Communications, Japan; Koyama, Shoji, University of Electro-Communications, Japan; Higuchi, Tomoo, University of Electro-Communications, Japan; Sugito, Yasuo, University of Electro-Communications, Japan; Shi, J., University of Electro-Communications, Japan; Ochiai, Tsutomu, University of Electro-Communications, Japan; Yokosuka, Masaru, University of Electro-Communications, Japan; Sasaki, Yukihiko, University of Electro-Communications, Japan; Bulletin of the University of Electro-Communications; December 1998; Volume 11, No. 2, pp. 125-135; In Japanese; See also 19990053546; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Grains and ferroelectric domains of Pb(1-x)L(x)(Zr(y)Ti(1-y)(1-x/4)O3 ceramics have been observed using a transmission electron microscope near the tetragonal- rhombohedral phase boundaries. The domain boundaries of the rhombohedral ceramics were clearer than those of the tetragonal ceramics. Fine ferroelectric domains of the non-poled ceramics became finer after poling and no single domain grains were observed, contrary to those expected through optical microscopes. These characteristics can affect the acoustic, optical and electric properties after poling.
Author
Rhombohedrons; Hot Pressing; Domains; Ceramics; Acoustic Properties

19990053548 University of Electro-Communications, Dept. of Applied Physics and Chemistry, Tokyo, Japan
Acoustic, Optical and Piezoelectric Properties of Pb(1 - x)La(x)(Zr(y)Ti(1 - y)(1 - x/4)O3(PLZT) Ceramics in Relation to Grain and Ferroelectric Domain Structures
Mitsuhashi, Hideto, University of Electro-Communications, Japan; Kato, Yasuyuki, University of Electro-Communications, Japan; Kawai, Takeo, University of Electro-Communications, Japan; Usui, Yuko, University of Electro-Communications, Japan; Yonekawa, Takeshi, University of Electro-Communications, Japan; Ochiai, Tsutomu, University of Electro-Communications, Japan; Yokosuka, Masaru, University of Electro-Communications, Japan; Sasaki, Yukihiko, University of Electro-Communications, Japan; Bulletin of the University of Electro-Communications; December 1998; Volume 11, No. 2, pp. 137-143; In Japanese; See also 19990053546; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Acoustic absorption, optical transmittance and piezoelectric resonance of hot-pressed Pb (1-x)La(x)(Zr(y)Ti(1-y)(1-x/4)O3(PLZT) ceramics have been discussed in relation to grain and domain structure in the non-poled or poled states observed through a transmission electron microscope. Acoustic attenuation is even larger in poled states and optical transmittance is lower in the poled states. In the non-poled states of PLZT near the tetragonal-rhombohedral morphotropic phase boundaries, the acoustic attenuation factor of the rhombohedral PLZT was distinctly smaller than that of the tetragonal PLZT.
Author
Acoustic Properties; Piezoelectricity; Ceramics; Rhombohedrons; Lead Zirconate Titanates

19990053550 University of Electro-Communications, Dept. of Electronic Engineering, Tokyo, Japan
Preparation and Characterization of Nitrogen-Doped Diamond-Like Carbon (DLC) Thin Films
Yoshinaga, Norihide, University of Electro-Communications, Japan; Okuyama, Naoki, University of Electro-Communications, Japan; Bulletin of the University of Electro-Communications; December 1998, pp. 157-160; In Japanese; See also 19990053546; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Nitrogen-doped diamond-like carbon (DLC) thin films have been successfully prepared from a plasma of CH4 and N2 gas mixture diluted by He in a simple rf glow discharge apparatus with plane-parallel electrodes. IR spectroscopic studies of films prepared in lower N2 fraction gas show that N atoms are substitutionally incorporated into graphitic clusters of DLC film. The films prepared in higher N2 fraction gas are soft and seem to be composed of polymeric compounds a- CN(x):H. The optical band gap obtained from Tauc relationship is explained based on the electronic structure expected front IR studies.
Author
Product Development; Diamonds; Doped Crystals; Electronic Structure; Carbon

19990053609 Army Research Lab., Vehicle Technology Directorate, Hampton, VA USA
Adhesive Model with Varying Interfacial Layers Using Longitudinal Ultrasound
Roberts, Mark J., Army Research Lab., USA; Anastasi, Robert, Army Research Lab., USA; Proceedings of the First Annual Symposium for Nondestructive Evaluation of Bond Strength; May 1999, pp. 20-28; In English; See also 19990053603; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Goals include: (1) Continue literature research as information becomes available; (2) Build on existing results provided by university grantees; (3) be open to new technologies (microwave, SAM, optics); (4) Provide lab experimentation ultrasonically on peel ply specimens which recommend ”weekend” bonds provided by Boeing Aircraft; and (5) Examine mathematical modeling possibilities.
Derived from text
Adhesives; Bonding; Adhesive Bonding; Microwaves; Ultrasonics

19990053662 Army Construction Engineering Research Lab., Engineering and Materials Div., Champaign, IL USA
Ceramic Coated Piston Rods for Civil Works *Final Report*
Weber, Robert A., Army Construction Engineering Research Lab., USA; Zatorski, Raymond, Army Construction Engineering Research Lab., USA; Apr. 1999; 48p; In English

Report No.(s): AD-A362682; USACERL-TR-99/36; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The U.S. Army Corps of Engineers uses many hydraulic pistons on its Civil Works structures. Recent failures of ceramic coated piston rods in the Jacksonville District indicate that specifications for these rods need to be updated and enhanced. This report discusses results of tests performed on carbon steel rods with varying bond coats applied with one of several methods. Top coats were also varied, and sealers were used only on some of the specimens. Testing was to determine hardness and corrosion/impact resistance. Conclusions drawn in this study will be used to recommend modifications to Corps of Engineers Guide Specification 15010.

DTIC

Ceramic Coatings; Sprayed Coatings; Metal Coatings; Pistons

19990053792 Xform, Inc., Cohoes, NY USA

Upscaled Self-Propagating High-Temperature Synthesis (SHS)/Dynamic Compaction Processing ***Final Report, Apr. 1991 - Jan. 1992***

Cooper, R. M., Xform, Inc., USA; Apr. 1999; 59p; In English

Contract(s)/Grant(s): DAAA15-91-C-0071

Report No.(s): AD-A362636; ARL-CR-439; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Titanium carbide (TiC) and titanium diboride (TiB2 ceramics were formed from elemental powders using a Gleeble 1500 dynamic thermomechanical process simulator. In the first step of a two-step process, a self-propagating high-temperature synthesis (SHS) reaction was initiated by the passage of an electric current through the powdered green body. The temperature of the body was maintained at about 800 deg C, and the reaction rate was controlled by the application of a pressure of about 35 MPa. As verified by x-ray diffraction analysis, this procedure resulted in complete conversion from reactants into products having a range of densities from 72 to 75% of theoretical. In the second step, the current was increased to raise the temperature of the material, thereby sintering and densifying the product. TiC with 3 wt.% nickel (Ni) was sintered to 95 to 98% of theoretical density, while TiC without Ni was sintered to 90% theoretical density. Although TiB2 was successfully converted, efforts to fully densify the product were hindered by the limitations of the Gleeble 1500. The effects of the current and pressure levels on the product density and microstructure were examined. The advantages and limitations of this process are also discussed.

DTIC

Ceramics; High Temperature; Synthesis (Chemistry); Chemical Reactions; Reaction Kinetics; Self Propagation

19990053794 Wisconsin Univ., Dept. of Nuclear Engineering, Madison, WI USA

Synthesis and Characterization of Diamond-Like Carbon Coatings Deposited by Plasma Source Ion Implantation and Conventional Ion Beam Assisted Deposition Processes

Stout, Brian M., Wisconsin Univ., USA; Jan. 1999; 52p; In English

Report No.(s): AD-A362850; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Diamond-like carbon coatings produced by Plasma Source Ion Implantation (PSII) and beamline Ion Beam Assisted Deposition (IBAD) were synthesized and studied. Gas pressure and electrical current were used as variables to design four independent PSII test sets. Beamline IBAD samples were produced with a pre-optimized set of parameters. Profilometry measurements showed the films to have thicknesses between 1.44 +/- .09 and 1.64 +/- .04 microns and to possess very low roughness averages, ranging from 14 +/- 3 to 28 +/- 3 nm, which correlate with substrate surface roughness. Atomic Force Microscopy revealed that diamond-like carbon crystal sizes varied significantly with chamber pressure. Crystals were generally spherical in shape suggesting that films were highly amorphous. Microhardness and nanohardness test results showed the hardest films to be greater than 3 times the hardness of untreated steel. The elastic modulus of the films, measured during the nanohardness test, was directly related to film hardness. Fretting wear and Pin-on-Disk tests were performed to quantitatively assess the ability of films to resist wear. Fretting wear tests showed a dramatic decrease in friction for diamond-like carbon films with friction levels ranging from 10% to 30% of that of untreated steel. Pin-on-Disk tests revealed a significant improvement in wear resistance prior to stylus penetration into the substrate.

DTIC

Diamond Films; Coatings; Ion Beams; Ion Implantation; Plasmas (Physics)

19990053816 Lawrence Livermore National Lab., Livermore, CA USA

Defect study in fused silica using near field scanning optical microscopy

Yan, M.; Wang, L.; Siekhaus, W.; Kozlowski, M.; Yang, J.; Jan. 21, 1998; 7p; In English; Annual Boulder damage symposium on optical materials for high power lasers

Report No.(s): DE98-054774; UCRL-JC-129506; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Surface defects in fused silica have been characterized using Near Field Scanning Optical Microscopy (NSOM). Using total internal reflection of a p- or s-polarized laser beam, optical scattering from defects located on the surface itself as well as in the subsurface layer of polished fused silica has been measured by NSOM. The local scattering intensity has been compared with simultaneously measured surface topography. In addition, surface defects intentionally created on a fused silica surface by nano-indentation have been used to establish a correlation between optical scattering of s- and p- polarized light, surface morphology and the well known subsurface stress-field associated with nano-indentation.
NTIS
Surface Defects; Silica Glass; Physical Optics; Morphology

19990053873 UES, Inc., Dayton, OH USA
Performance Evaluation of Some Pennzane-Based Greases for Space Applications
Rai, A. K., UES, Inc., USA; Massey, M. L., UES, Inc., USA; Gschwender, L. J., Air Force Research Lab., USA; Snyder, C. E., Jr., Air Force Research Lab., USA; Zabinski, J. S., Air Force Research Lab., USA; Sharma, S. K., Air Force Research Lab., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 213-220; In English; See also 19990053852
Contract(s)/Grant(s): F33615-97-C-5099; F33615-98-C-5031; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche
To satisfy the tribological requirements of future spacecraft, improvements in lubricant performance are needed. A considerable amount of progress has been made in developing improved lubricants, additives, and materials, however, their performance has yet to be tested and ranked. In the present work, we have employed four ball and Cameron Plint techniques to rank and evaluate the performance of various Pennzane-based greases, either alone or in combination with coatings.
Author
Greases; Aerospace Systems; Lubricants; Lubricant Tests; Tribology; Lubrication; Performance Tests

19990053890 Department of the Navy, Washington, DC USA
Linear Carborane-(Siloxane or Silane)-Acetylene Based Copolymers
Keller, Teddy M., Inventor; Son, David Y., Inventor; Jul. 14, 1998; 24p; In English; Supersedes US-Patent-Appl-SN-337012, AD-D017321.
Patent Info.: Filed 7 Nov. 94,; US-Patent-Appl-SN-337,012; US-Patent-5,780,569
Report No.(s): AD-D019310; No Copyright; Avail: US Patent and Trademark Office, Microfiche
The invention pertains to a novel organoboron polymer and its method of preparation is claimed. The organoboron polymer has a backbone having a repeating unit comprising at least one carboranyl group, at least two acetylenic groups, and one or more silyl or siloxanyl groups.
DTIC
Copolymers; Plastics; Acetylene; Thermal Stability; Thermosetting Resins

19990053902 Department of the Navy, Washington, DC USA
Linear Metallocene Polymers Containing Acetylenic and Inorganic Units and Thermosets and Ceramics Therefrom
Keller, Teddy M., Inventor; Houser, Eric J., Inventor; Dec. 01, 1998; 18p; In English; Supersedes US-Patent-Appl-SN-818686, AD-D018579.
Patent Info.: Filed 14 Mar. 97,; US-Patent-Appl-SN-818,686; US-Patent-5,844,052
Report No.(s): AD-D019327; No Copyright; Avail: US Patent and Trademark Office, Microfiche
Thermally stable thermosets are formed from novel linear polymer containing acetylenic units and a random distribution of organotransition metal complexes, siloxane, boron, and/or carborane-siloxane units formed by crosslinking of the linear copolymers through the acetylene units in the polymer backbone. The thermosets can be used as structural components in high temperature and oxidizing environments or as pyrolytic precursors to metal containing ceramics, ceramic films and fibers having enhanced strength and toughness with superior mechanical, optical, electrical and/or magnetic properties.
DTIC
Transition Metals; Polymers; Thermal Stability; Statistical Distributions; High Temperature Environments; Acetylene; Carborane

19990054180 Idaho National Engineering Lab., Idaho Falls, ID USA

Flame spraying of polymers

Varacalle, D. J.; Zeek, D. P.; Couch, K. W.; Benson, D. M.; Kirk, S. M.; Dec. 31, 1997; 8p; In English; National thermal spray conference

Report No.(s): DE97-053253; INEL/CON-97-00532; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Statistical design-of-experiment studies of the thermal spraying of polymer powders are presented. Studies of the subsonic combustion (i.e., Flame) process were conducted in order to determine the quality and economics of polyester and urethane coatings. Thermally sprayed polymer coatings are of interest to several industries for anticorrosion applications, including the chemical, automotive, and aircraft industries. In this study, the coating design has been optimized for a site-specific application using Taguchi-type fractional- factorial experiments. Optimized coating designs are presented for the two powder systems. A substantial range of thermal processing conditions and their effect on the resultant polymer coatings is presented. The coatings were characterized by optical metallography, hardness testing, tensile testing, and compositional analysis. Characterization of the coatings yielded the thickness, bond strength, Knoop microhardness, roughness, deposition efficiency, and porosity. Confirmation testing was accomplished to verify the coating designs.

NTIS

Polymers; Flame Spraying; Polyesters; Urethanes; Coatings; Powder (Particles); Sprayed Coatings

19990054333 Department of the Navy, Washington, DC USA

Sealing Ring with Deformable Tubular Sheath Filled with Permanent Magnetic Granules and Method of Making the Same

Cho, Chahee P., Inventor; Krol, William P., Jr., Inventor; Amaral, Antonlo M., Inventor; Oct. 27, 1998; 6p; In English; Supersedes US-Patent-Appl-SN-715263, AD-D018200.

Patent Info.: Filed 16 Sep. 96,; US-Patent-Appl-SN-715,263; US-Patent-5,826,883

Report No.(s): AD-D019295; No Copyright; Avail: US Patent and Trademark Office, Microfiche

There is provided an endless tubular body forming an enclosed chamber therein, and granules of permanent magnet material disposed in the chamber. The body is deformable by the granules when the granules are subjected to a magnetic force. With respect to the aspect of the invention wherein seal assembly technology is the center of interest, there are provided a first member of magnetically permeable material and a second member spaced from the first member to define a passageway there between, and the above described sealing ring is disposed in the passageway between the first and second members and in engagement therewith. With respect to the aspect of the of the invention wherein the technology of making a seal assembly is the center of interest, there is provided a method for making the above-described seal assembly.

DTIC

Permanent Magnets; Sealing; Sheaths; O Ring Seals

19990054413 Cincinnati Univ., OH USA

Development of Some Promising Approaches for the Toughening of High-Temperature Polymers ***Final Report, 1 Mar. 1996 - 28 Feb. 1999***

Kumudinie, C.; Premachandra, J. K.; Mark, J. E.; Unroe, M. R.; Arnold, F. E.; May 17, 1999; 6p; In English

Contract(s)/Grant(s): F49620-96-1-0052

Report No.(s): AD-A363643; AFRL-SR-BL-TR-99-0133; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A number of polymers of interest and importance to the U.S. Air Force have a degree of brittleness that limits their utilization. This brittleness was reduced, and a number of the physical properties improved, by the in-situ introduction of dispersed elastomeric phases. The approach was a modification of the sol-gel technique previously used to introduce much harder ceramic-like phases into similar polymers. Specifically, precursor molecules were chosen so that their hydrolyses did not produce a ceramic such as silica, but one in which organic groups flexibilize the phases. This increases extensibility and thereby toughness, and has some additional benefits such as decrease of water absorption.

DTIC

Toughness; Polymers; High Temperature

19990054414 Cornerstone Research Group, Inc., Dayton, OH USA

High-Performance Liquid Crystal Adhesives ***Final Report, 1 Sep. 1998 - 28 Feb. 1999***

Hood, Patrick J.; Apr. 22, 1999; 25p; In English

Contract(s)/Grant(s): F49620-98-C-0054

Report No.(s): AD-A363644; AFRL-SR-BL-TR-99-0131; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

High-temperature, easy-to-process adhesives are needed for adhesively bonded joints, and composite patch repair. Resins, such as epoxies, that are currently used are processable at temperatures below 200 C but have low upper-use temperatures. High-performance polyimides can be used at temperatures exceeding 300 C, but must be processed above 300 C. Low processing temperatures are needed for easy field repair as well as cost effective manufacturing processes. It is most desirable to have materials that are both easy to process and have high thermal stability. A high-temperature, low-shrinkage, easy-to-process adhesive based on liquid crystal monomers with reactive end groups was developed and evaluated in this program. In addition, an integrated fiber sensor for sensing moisture in the adhesive was investigated. During the Phase I effort a high-performance liquid crystal monomer was synthesized and a fiber optic moisture sensor was demonstrated. The liquid crystal monomer was evaluated and showed thermal stability up to 300 C with curing below 150 C. A Phase II proposal has been submitted focusing on further development and characterization of the adhesive material.

DTIC

Adhesives; Liquid Crystals

19990054473 Kyoto Univ., Dept. of Chemistry, Japan

Significance of collective motions in biopolymers and neutron scattering

Go, Nobuhiro, Kyoto Univ., Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 30-33; In English; See also 19990054467; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The importance of collective variable description of conformational dynamics of biopolymers and the vital role that neutron inelastic scattering phenomena would play in its experimental determination are discussed.

Author

Biopolymers; Proteins; Neutron Scattering

19990054474 Kyoto Univ., Inst. for Chemical Research, Japan

Dynamics of amorphous polymers as studied by neutron scattering

Kanaya, Toshiji, Kyoto Univ., Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 34-38; In English; See also 19990054467; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

In the last decade dynamics of polymers in bulk state has been studied by quasi and inelastic neutron scattering techniques in the time range of 10(exp -13) s to 10(exp -10) s using LAM spectrometers (LAM-40 and LAM-80ET) at KEK. The works can be classified into three parts: (1) dynamics in glassy state, (2) dynamics near glass transition and (3) dynamics in molten state. In the present paper we review our studies on the low energy excitation in glassy polymers, which is an origin of anomalous thermal properties of amorphous materials at low temperatures.

Author

Amorphous Materials; Neutron Scattering; Polymers; Thermodynamic Properties; Glass; Crystallinity

19990054484 Argonne National Lab., Intense Pulsed Neutron Source, IL USA

Property characterization of technical ceramics: added capabilities from an advanced pulsed neutron source

Loong, C.-K., Argonne National Lab., USA; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 87-93; In English; See also 19990054467

Contract(s)/Grant(s): W-31-109-eng-38; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Neutrons provide a means to explore the basic, microscopic properties of materials. Examples of neutron studies of important technical ceramics are given to illustrate the potential benefits in the improvements of the environment, energy systems, and communication and the need for better neutron facilities and instrumentation.

Author

Ceramics; Neutron Sources; Neutrons; Neutron Scattering; Air Pollution; Internal Combustion Engines; Optical Fibers; Laser Materials; Technology Assessment

19990054490 Basel Univ., M. E. Mueller Inst., Switzerland

Actin: Dissecting the Structural Basis of its Oligomerization, Polymerization and Polymorphism

Steinmetz, Michel O., Basel Univ., Switzerland; Stoffler, Daniel, Basel Univ., Switzerland; Aebi, Ueli, Basel Univ., Switzerland;

The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 337-341; In English; See also 19990054485; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

At first glance, the ”actin polymerization” problem may appear to have been solved: that is, it involves a simple nucleation-condensation mechanism following psuedo-first-order assembly kinetics leading to a steady state. Although there is general agreement that one of the first steps in the polymerization reaction of G-actin into F-actin filaments involves dimerization of a significant fraction of the monomer pool, evidence has been presented that this dimer called the lower dimer (LD), is in a G-like conformation and is unable to polymerize into F-actin filaments. Hence LD formation may represent an unproductive side reaction similar to the ring formation occuring during the oscillating cycle of assembly and disassembly seen in microtubules. This research has demonstrated that LD, while being unproductive by itself, can be added to growing f-actin filaments via one of its subunits. Slowly but definitely the surplus monomers, dissociate from these partially LD decorated filaments to yield bona fide F-actin filaments at steady state. These findings suggest, that F-actin polymerization may involve multiple pathways rather than a simple nucleation-condensation mechanism.
Derived from text

Polymerization; Polymorphism; Prepolymers; Cytology; Cells (Biology); Cell Membranes (Biology); Cytogenesis

19990054644 NASA Lewis Research Center, Cleveland, OH USA

Elevated-Temperature ”Ultra” Fast Fracture Strength of Advanced Ceramics: An Approach to Elevated-Temperature ”Inert” Strength

Choi, S. R., NASA Lewis Research Center, USA; Gyekenyesi, J. P., NASA Lewis Research Center, USA; Transactions of the ASME; January 1999; Volume 121, pp. 18-24; In English; International Gas Turbine and Aeroengine Congress and Exhibition, 2-5 Jun. 1998, Stockholm, Sweden; Sponsored by American Society of Mechanical Engineers, USA

Contract(s)/Grant(s): DE-AC05-96OR-22464
Report No.(s): ASME Paper 98-GT-479; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The determination of ”ultra” fast fracture strengths of five silicon nitride ceramics at elevated temperatures has been made by using constant stress-rate (”dynamic fatigue”) testing with a series of ”ultra” fast test rates. The test material included four monolithic and one SiC whisker-reinforced composite silicon nitrides. of the five test materials, four silicon nitrides exhibited the elevated -temperature strengths that approaches their respective room-temperature strengths at an ”ultra” fast test rate of 3.3 x 10(exp 4) MPa/s. This implies that slow cracks growth responsible for elevated-temperature failure can be eliminated or minimized by using the ”ultra” fast test rate. These ongoing experimental results have shed light on laying a theoretical and practical foundation on the concept and definition of elevated-temperature ”inert” strength behavior of advanced ceramics.
Author

Ceramics; Fracture Strength; Silicon Nitrides; Thermal Stresses; Whisker Composites

19990054653 National Taipei Univ. of Technology, Dept. of Materials and Mineral Resources Engineering, Taipei, Taiwan, Province of China

Liquid Phase Sintering and Chemical Inhomogeneity in the BaTiO3-BaCO3-LiF System

Wang, Sea-Fu, National Taipei Univ. of Technology, Taiwan, Province of China; Cheng, Kung-Chiee, National Taipei Univ. of Technology, Taiwan, Province of China; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1998; ISSN 0253-3839; Volume 22, No. 1, pp. 61-68; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

An ongoing goal of multilayer capacitor research is to lower the firing temperature of the dielectric. This paper gives a comprehensive study of sintering BaTiO3 with LiF flux which lowers the firing temperature through liquid phase sintering. A detailed set of experiments is discussed concerning microstructural evolution and corresponding dielectric properties under two processing variables: amount of LiF and sintering temperature. Different scales of chemical inhomogeneity were observed in this system which reflect two underlying mechanisms: solution reprecipitation with limited grain growth at low temperatures, which resulted in distinct core-shell structures, and flux volatility, which gave rise to microscopic chemical inhomogeneity at higher sintering temperatures.
Author

Liquid Phase Sintering; Ferroelectricity; Ferroelectric Materials; Dielectric Properties; Barium Titanates; Titanium Oxides; Carbonates; Lithium Fluorides

28
PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.

19990054058 California Univ., MAE Dept., Davis, CA USA
Combustion of Han-Based Monopropellant Droplets in Reduced Gravity
Shaw, B. D., California Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 403-406; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The objective of this research is to study combustion of monopropellant droplets and monopropellant droplet components in reduced-gravity environments so that spherical symmetry is strongly promoted. The experiments will use hydroxylammonium nitrate (HAN, chemical formula NH3OHNO3) based monopropellants. This class of monopropellant is selected for study because of its current relevance and also because it is relatively benign and safe to work with. The experimental studies will allow for accurate determination of fundamental data on deflagration rates, gas-phase temperature profiles, transient gas-phase flame behaviors, the onset of bubbling in droplets at lower pressures, and the low-pressure deflagration limit. The theoretical studies will provide rational models of deflagration mechanisms of HAN-based liquid propellants. Besides advancing fundamental knowledge, the proposed research should aid in applications (e.g., spacecraft thrusters and liquid propellant guns) of this unique class of monopropellants.
Derived from text
Drops (Liquids); Liquid Rocket Propellants; Microgravity; Monopropellants; Propellant Combustion; Hydroxyl Compounds; Ammonium Nitrates

19990054194 New York State Electric and Gas Corp., Binghamton, NY USA
E-FUEL(TM): Beneficial Use of Paper Mill Sludge *Final Report*
Oct. 1998; 96p; In English
Report No.(s): PB99-133142; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report evaluates the technical, market, and economic aspects of using paper mill sludge along with coal to make a fuel pellet for the industrial stoker coal market. The product, called E-Fuel(TM), uses technology developed by one of the project participants. to service the industrial market, the E-Fuel needs to have few fines, be weather-resistant, and have a minimum heating value of 12,000 Btu/lb and a sulfur content of 1.0% or less. The project established that at least 380,000 tons of paper sludge are being landfilled in New York each year and that there is an industrial stoker coal market of at least 263,000 tons per year. These numbers are adequate for a 150,000-ton per year E-Fuel plant, which would cost $5.3 million. E-Fuel is economically competitive in the current New York stoker coal market and provides a positive return. However, the return is lower than is required by typical private investors. to have returns that would attract private investment, New York environmental authorities would have to permit existing coal-fired units to burn 100% E-fuel, with the provision that E-Fuel be limited to less than 30% waste, and a tipping fee would have to be received on the waste that would be about 60% of the current market fee.
NTIS
Coal; Fuel Capsules; Alternatives

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MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications. For biological materials see 55 Space Biology.

19990053965 NASA Glenn Research Center, Cleveland, OH USA
Fifth International Microgravity Combustion Workshop
Sacksteder, Kurt, Compiler, NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999; 548p; In English, 18-20 May 1999, Cleveland, OH, USA; See also 19990053966 through 19990054085
Contract(s)/Grant(s): RTOP 962-22-00
Report No.(s): NASA/CP-1999-208917; E-11671; NAS 1.55:208917; No Copyright; Avail: CASI; A23, Hardcopy; A04, Microfiche

This conference proceedings document is a compilation of 120 papers presented orally or as poster displays to the Fifth International Microgravity Combustion Workshop held in Cleveland, Ohio on May 18-20, 1999. The purpose of the workshop is to

present and exchange research results from theoretical and experimental work in combustion science using the reduced-gravity environment as a research tool. The results are contributed by researchers funded by NASA throughout the USA at universities, industry and government research agencies, and by researchers from at least eight international partner countries that are also participating in the microgravity combustion science research discipline. These research results are intended for use by public and private sector organizations for academic purposes, for the development of technologies needed for the Human Exploration and Development of Space, and to improve Earth-bound combustion and fire-safety related technologies.
Author
Conferences; Microgravity; Gravitational Effects; Combustion Physics; Combustion Chemistry; Flames; Mathematical Models; Computerized Simulation

19990053966 NASA, Washington, DC USA
NASA Microgravity Combustion Science Program
King, Merrill K., NASA, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 3-8; In English; See also 19990053965; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Combustion has been a subject of increasingly vigorous scientific research for over a century, not surprising considering that combustion accounts for approximately 85% of the world's energy production and is a key element of many critical technologies used by contemporary society. Although combustion technology is vital to our standard of living, it also poses great challenges to maintaining a habitable environment. A major goal of combustion research is production of fundamental (foundational) knowledge that can be used in developing accurate simulations of complex combustion processes, replacing current "cut-and-try" approaches and allowing developers to improve the efficiency of combustion devices, to reduce the production of harmful emissions, and to reduce the incidence of accidental uncontrolled combustion. With full understanding of the physics and chemistry involved in a given combustion process, including details of the unit processes and their interactions, physically accurate models which can then be used for parametric exploration of new combustion domains via computer simulation can be developed, with possible resultant definition of radically different approaches to accomplishment of various combustion goals. Effects of gravitational forces on earth impede combustion studies more than they impede most other areas of science. The effects of buoyancy are so ubiquitous that we often do not appreciate the enormous negative impact that they have had on the rational development of combustion science. Microgravity offers potential for major gains in combustion science understanding in that it offers unique capability to establish the flow environment rather than having it dominated by uncontrollable (under normal gravity) buoyancy effects and, through this control, to extend the range of test conditions that can be studied. It cannot be emphasized too strongly that our program is dedicated to taking advantage of microgravity to untangle complications caused by gravity, allowing major strides in our understanding of combustion processes and in subsequent development of improved combustion devices leading to improved quality of life on Earth. Fire and/or explosion events aboard spacecraft could be devastating to international efforts to expand the human presence in space. Testing to date has shown that ignition and flame spread on fuel surfaces (e.g., paper, wire insulation) behave quite differently under partial gravity and microgravity conditions. In addition, fire signatures-i.e., heat release, smoke production, flame visibility, and radiation-are now known to be quite different in reduced gravity environments; this research has provided data to improve the effectiveness of fire prevention practices, smoke and fire detectors, and fire extinguishment systems. The more we can apply our scientific and technological understanding to potential fire behavior in microgravity and partial gravity, the more assurance can be given to those people whose lives depend on the environment aboard spacecraft or eventually on habitats on the Moon or Mars.
Derived from text
Combustion Physics; Microgravity; Gravitational Effects; NASA Programs; Research and Development

19990053967 European Space Agency. European Space Research and Technology Center, ESTEC, Directorate of Manned Spaceflight and Microgravity, Noordwijk, Netherlands
Space Station Utilisation Initiatives of the European Space Agency ESA/ESTEC
Kufner, Ewald, European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Fifth International Microgravity Combustion Workshop; May 1999, pp. 9-12; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The overall strategic objective of ESA's Microgravity Applications Programme (MAP) is to generate a European activity using the International Space Station (ISS) as a facility for applications-oriented research and eventually for industrial R&D in the long-term. Applications of microgravity may be understood as the exploitation of the ISS for applied research and as a testbed for the development of technology and processes useful on Earth and for long-duration space flight.
Derived from text
European Space Agency; International Space Station; Microgravity Applications

19990053968 NASA Glenn Research Center, Cleveland, OH USA

Solid Inflammability Boundary at Low Speed (SIBAL)

T'ien, James S., Case Western Reserve Univ., USA; Ferkul, Paul, National Center for Microgravity Research on Fluids and Combustion, USA; Sacksteder, Kurt R., NASA Glenn Research Center, USA; Shih, Hsin-Yi, Case Western Reserve Univ., USA; Bedir, Hasan, Case Western Reserve Univ., USA; Greenberg, Paul S., NASA Glenn Research Center, USA; Pettegrew, Richard D., National Center for Microgravity Research on Fluids and Combustion, USA; Piltch, Nancy, NASA Glenn Research Center, USA; Frate, David, NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 15-18; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This research program is concerned with the effect of low-speed, concurrent flow on the spreading and extinction processes of flames over solid fuels. The primary objective is to verify the theoretically predicted extinction boundary, using oxygen percentage and flow velocity as coordinates. In particular, we are interested in the low-speed quenching limits and the existence of the critical oxygen flammability limit. Detailed flame spread characteristics, including flame spread rate, flame size, and flame structure are sought. Since the predicted flame behavior depends on the inclusion of flame and surface radiation, the measured results will also be used to assess the importance of radiative heat transfer by direct comparison to a comprehensive numerical model. This project passed the Science Concept Review (SCR) in 1996. As a result, the experiment continues on the flight definition path, and is currently scheduled to be performed in the Space Station Combustion Integrated Rack (CIR). We present an overview of recent and ongoing work, including selected experimental and theoretical topics.

Author

Flammability; Boundaries; Low Speed; Extinction; Mathematical Models; Radiative Heat Transfer; Flame Propagation; Solid Propellant Combustion

19990053969 Princeton Univ., Dept. of Mechanical and Aerospace Engineering, NJ USA

Some Recent Observations on the Burning of Isolated N-Heptane and Alcohol Droplets

Dryer, F. L., Princeton Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 19-22; In English; See also 19990053965

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In a joint program involving Prof F.A. Williams of the University of California, San Diego and Dr. Vedha Nayagam of the National Center for Microgravity Research on Fluid and Combustion, the combustion of liquid fuel droplets having initial diameters between about 1 mm and 6 mm is being studied. The objectives of the work are to improve fundamental knowledge of droplet combustion dynamics through microgravity experiments and theoretical analyses. The Princeton contributions to the collaborative program supports the engineering design, data analysis, and data interpretation requirements for the study of initially single component, spherically symmetric, isolated droplet combustion studies through experiments and numerical modeling. The complementary UCSD contributions apply asymptotic theoretical analyses and are described in the published literature and in a companion communication in this volume. Emphases of the Princeton work are on the study of simple alcohols (methanol, ethanol), alcohol/water mixtures, and pure alkanes (n-heptane, n-decane) as fuels, with time dependent measurements of drop size, flame-stand-off, liquid-phase composition, and finally, extinction. Ground based experiments have included bench-scale studies at Princeton and collaborative experimental studies in the 2.2 and 5.18 second drop towers at NASA-Glenn Research Center. Spacelab studies have included fiber-supported droplet combustion (FSDC) experiments in the Glovebox facility with accompanying numerical analyses. Experiments include FSDC-1, performed on the USML-2 mission in October, 1995 (STS-73) and FSDC-2, on the second flight of the MSL-1 mission in July, 1997 (STS-94).

Derived from text

Heptanes; Alcohols; Hydrocarbon Combustion; Hydrocarbon Fuels; Drops (Liquids); Spaceborne Experiments; Gravitational Effects; Mathematical Models

19990053970 University of Southern California, Department of Aerospace and Mechanical Engineering, Los Angeles, CA USA

Dynamics and Structure of Weakly-Strained Flames In Normal- and Micro-Gravity

Zhang, Hai, University of Southern California, USA; Vagelopoulos, Christine M., University of Southern California, USA; Egolfopoulos, Fokion N., University of Southern California, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 23-26; In English; See also 19990053965

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Strained laminar flames have been systematically studied, as the understanding of their structure and dynamic behavior is of relevance to turbulent combustion. Most of these studies have been conducted in opposed-jet, stagnation-type flow configurations. Flame studies in stagnation flows also allow for the determination of fundamental flame properties such as laminar flame speeds and extinction states that can be also conveniently modeled in detail. Studies at high strain rates are important in quantifying

and understanding the response of vigorously-burning flames under conditions in which the transport time scales become comparable to the chemical time scales. Studies of weakly-strained flames can be of particular interest for all stoichiometries. For example, the laminar flame speeds for any equivalence ratio, phi, can be accurately determined by using the counterflow technique only if measurements are obtained at very low strain rates. Furthermore, near-limit flames can be only stabilized by weak strain rates. Previous studies have shown that weakly-burning flames are particularly sensitive to chain mechanisms, thermal radiation, and unsteadiness. The stabilization and study of weakly-strained flames is complicated by the presence of buoyancy that can render the flames unstable to the point of extinction. Such instabilities are caused either by the induced natural convection or the fact that higher density fluid can find itself on top of a lower density fluid. Thus, the use of microgravity (mu-g) becomes essential in order to provide meaningful insight into this important combustion regime. In view of the foregoing considerations, the main objectives of the program are to: (1) Experimentally determine the laminar flame speed at near-zero strain rates; (2) Experimentally determine the extinction limits of near-limit flames; (3) Experimentally determine the response of near-limit flames to unsteadiness and heat loss; (4) Introduce Digital Particle Image Velocimetry (DPIV) in microgravity; (5) Conduct detailed numerical simulations of the experiments; and (6) Provide physical insight into the underlying physico-chemical mechanisms.
Derived from text
Flames; Laminar Flow; Dynamic Characteristics; Microgravity; Gravitational Effects; Buoyancy; Stagnation Flow; Strain Rate; Flame Stability; Flame Propagation; Computerized Simulation; Physical Chemistry

19990053971 NASA Glenn Research Center, Cleveland, OH USA
Reflight of the Solid Surface Combustion Experiment: Flame Radiation Near Extinction
Altenkirch, R. A., Mississippi State Univ., USA; Bundy, M. F., Washington State Univ., USA; Tang, L., Mississippi State Univ., USA; Bhattacharjee, S., San Diego State Univ., USA; Sacksteder, K., NASA Glenn Research Center, USA; Delichatsios, M. A., Commonwealth Scientific and Industrial Research Organization, Australia; Fifth International Microgravity Combustion Workshop; May 1999, pp. 27-30; In English; See also 19990053965
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In flame spreading in quiescent and low-velocity opposing flows, effects of surface reradiation and flame radiation are important in establishing the spread rate and whether the flame, once ignited, survives to steady spread or extinguishes after a time long compared to the ignition event. A reflight of the Solid Surface Combustion Experiment (SSCE), supported by modelling, demonstrates that for thick, flat fuels, the ultimate fate of the flame is extinction rather than steady spread. A mismatch between the thermal scale in the gas, driven by radiation, and the species diffusion scale, driven by mass diffusion, develops such that the high temperature regions of the flame are ultimately located in a region to which oxygen cannot be supplied at a sufficient rate to sustain reaction, and extinction occurs. Results of the experiment conducted on Space Shuttle mission STS 85 on 9 August 1997 are reviewed. For the flat surface geometry, while the hydrodynamic phenomena associated with opposed-flow flame spread may be treated two dimensionally, the radiative effects are three dimensional, and so modelling the radiative processes, with the mismatch in dimensionality, is difficult. The cylindrical geometry at least one long compared to the radius, provides a configuration in which the radiative processes for spread in the axial direction are two dimensional, thus simplifying the modelling. The cylindrical geometry allows for the development of more sophisticated radiative models without the complication of dimensionality concerns, e.g., discrete transfer, which is discussed in detail by Bundy (1998). Additionally, the cylindrical geometry results in a ”focussing” of the heat transfer to the surface and may allow for steady spread for radii that for thick fuels of the same half-thickness there is no steady spread.
Derived from text
Fuel Combustion; Flat Surfaces; Flame Propagation; Extinguishing; Extinction; Gravitational Effects; Spaceborne Experiments; Radiation Effects; Radiative Heat Transfer; Flame Stability

19990053972 National Center for Microgravity Research on Fluids and Combustion, Cleveland, OH USA
Edge-Flames in Von Karman Swirling Flows
Nayagam, Vedha, National Center for Microgravity Research on Fluids and Combustion, USA; Williams, Forman A., California Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 31-34; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Classical understanding of diffusion flames dictates that they, unlike the premixed flames, do not possess a characteristic propagation velocity and are constrained by stoichiometric requirements at the flame surface. However, it has been commonly observed that when local extinction occurs within a diffusion flame sheet, the edges that are formed propagate with distinct speeds. In general, the propagation speed of these edges depend on their geometrical shape (concave, convex, or straight) among other factors. Recently, Buckmaster investigated the dynamics of straight diffusion flame edges separating burning and quenched regions using simplified one-dimensional models. He showed that these flame edges can have positive, negative, or zero velocity

depending on the Damkoehler number of the equilibrium diffusion flame that support them. It was also shown that this unsteady flame-edge behavior is intrinsically linked to S-curve behavior of the diffusion flame with varying Damkoehler number. When the system Damkoehler number lies between the extinction and ignition limits, flame edges can propagate as an ”ignition wave” or as a ”failure wave,” and for a critical Damkoehler number remain as a stationary flame-edge. We have extend Buckmaster’s 1-d model to more general edge-flame configurations where the edges appear as ”flame holes” or as ”flame disks”. These two configurations along with the straight-edge case cover the entire range of possible edge-flame geometry observable in planar diffusion-flame sheets. A generalized map of edge-flame propagation velocities as a function of the system Damkoehler number and the edge-flame radius is presented. Experimentally we show that edge flames can be created using diffusion flames embedded in von Karman boundary layers. In a von Karman boundary layer, the flow is generated by spinning a solid (fuel) disk in a quiescent ambient gas. Under normal gravity we were able to produce ”flame disks” over a range of fuel-disk rotational velocities varying from 0 to 20 revolutions per second, by orienting the burning surface of the fuel disk facing downward.
Derived from text
Boundary Layer Combustion; Flame Propagation; Diffusion Flames; Propagation Velocity; Damkohler Number; One Dimensional Flow; Mathematical Models

19990053973 NASA Glenn Research Center, Cleveland, OH USA
Flow Effects on the Flammability Diagrams of Solid Fuels: Microgravity Influence on Ignition Delay
Cordova, J. L., California Univ., USA; Walther, D. C., California Univ., USA; Fernandez-Pello, A. C., California Univ., USA; Steinhaus, T., Maryland Univ., USA; Torero, J. L., Maryland Univ., USA; Quintere, J. G., Maryland Univ., USA; Ross, H. D., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 35-38; In English; See also 19990053965
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The possibility of an accidental fire in space-based facilities is a primary concern of space exploration programs. Spacecraft environments generally present low velocity air currents produced by ventilation and heating systems (of the order of 0.1 m/s), and fluctuating oxygen concentrations around that of air due to CO2 removal systems. Recent experiments of flame spread in microgravity show the spread rate to be faster and the limiting oxygen concentration lower than in normal-gravity. to date, there is not a material flammability-testing protocol that specifically addresses issues related to microgravity conditions. The present project (FIST) aims to establish a testing methodology that is suitable for the specific conditions of reduced gravity. The concepts underlying the operation of the LIFT apparatus, ASTM-E 1321-93, have been used to develop the Forced-flow Ignition and flame-Spread Test (FIST). As in the LIFT, the FIST is used to obtain the flammability diagrams of the material, i.e., graphs of ignition delay time and flame spread rate as a function of the externally applied radiant flux, but under forced flow rather than natural convection conditions, and for different oxygen concentrations. Although the flammability diagrams are similar, the flammability properties obtained with the FIST are found to depend on the flow characteristics. A research program is currently underway with the purpose of implementing the FIST as a protocol to characterize the flammability performance of solid materials to be used in microgravity facilities. to this point, tests have been performed with the FIST apparatus in both normal-gravity and microgravity conditions to determine the effects of oxidizer flow characteristics on the flammability diagrams of polymethylmethacrylate (PMMA) fuel samples. The experiments are conducted at reduced gravity in a KC- 135 aircraft following a parabolic flight trajectory that provides up to 25 seconds of low gravity. The objective of the experiments is to obtain data of ignition delay and flame spread rate at low flow velocities (0.1 to 0.2 m/s), which cannot be obtained under normal gravity because of the natural convection induced flows (approx. 0.5 m/s). Due to the limited reduced gravity time, the data can only be obtained for high radiant fluxes, and are consequently limited in scope. These tests do, however, provide insight into the flammability diagram characteristics at low velocity and reduced gravity, and also into the implications of the flow-dependence of the flammability properties under environments similar to those encountered in space facilities.
Derived from text
Flow Characteristics; Flammability; Solid Propellant Combustion; Microgravity; Gravitational Effects; Parabolic Flight; Polymethyl Methacrylate; Solid Propellant Ignition; Fuel Combustion; Flame Propagation; Propagation Velocity

19990053974 Escuela Tecnica Superior de Ingenieros Aeronauticos, Madrid, Spain
Combustion and Flammability Characteristics of Solids at Microgravity in very Small Velocity Flows
Sanchez-Tarifa, C., Escuela Tecnica Superior de Ingenieros Aeronauticos, Spain; Rodriguez, M., Escuela Tecnica Superior de Ingenieros Aeronauticos, Spain; Fifth International Microgravity Combustion Workshop; May 1999, pp. 39-42; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Fires still remain as one of the most important safety risks in manned spacecraft. This problem will become even more important in long endurance non orbital flights in which maintenance will be non existing or very difficult. The basic process of a fire

is the combustion of a solid at microgravity conditions in O2/N2 mixtures. Although a large number of research programs have been carried out on this problem, especially on flame spreading, several aspects of these processes are not yet well understood. It may be mentioned, for example, the temperature and characteristic of low emissivity flames in the visual range that take place in some conditions at microgravity; and there exists a lack of knowledge on the influence of key parameters, such as convective flow velocities of the order of magnitude of typical oxygen diffusion velocities. The ”Departamento de Motopropulsion y Termofluidodinamica” of the ”Universidad Politecnica de Madrid, Escuela Tecnica Superior de Ingenieros Aeronauticos” is conducting a research program on the combustion of solids at reduced gravity conditions within O2/N2 mixtures. The material utilized has been polymethylmethacrylate (PMMA) in the form of rectangular slabs and hollow cylinders. The main parameters of the process have been small convective flow velocities (including velocity angle with the direction of the spreading flame) and oxygen concentration. Some results have also been obtained on the influence of material thickness and gas pressure.
Derived from text
Fuel Combustion; Flammability; Polymethyl Methacrylate; Flow Velocity; Low Speed; Microgravity; Gravitational Effects; Convective Flow; Flame Stability

19990053975 NASA Glenn Research Center, Cleveland, OH USA
Radiant Extinction of Gaseous Diffusion Flames
Berhan, Sean, Michigan Univ., USA; Atreya, Arvind, Michigan Univ., USA; Everest, David, Michigan Univ., USA; Sacksteder, Kurt R., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 43-46; In English; See also 19990053965
Contract(s)/Grant(s): NAG3-482; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The absence of buoyancy-induced flows in microgravity (mu-g) and the resulting increase in the reactant residence time significantly alters the fundamentals of many combustion processes. Substantial differences between normal gravity (ng) and mu-g flames have been reported in experiments on candle flames, flame spread over solids, droplet combustion, and others. These differences are more basic than just in the visible flame shape. Longer residence times and higher concentration of combustion products in the flame zone create a thermochemical environment that changes the flame chemistry and the heat and mass transfer processes. Processes such as flame radiation, that are often ignored in ng, become very important and sometimes even controlling. Furthermore, microgravity conditions considerably enhance flame radiation by: (1) the build-up of combustion products in the high-temperature reaction zone which increases the gas radiation; and (2) longer residence times make conditions appropriate for substantial amounts of soot to form which is also responsible for radiative heat loss. Thus, it is anticipated that radiative heat loss may eventually extinguish the ”weak” (low burning rate per unit flame area) mu-g diffusion flame. Yet, space shuttle experiments on candle flames show that in an infinite ambient atmosphere, the hemispherical candle flame in mu-g will burn indefinitely. This may be because of the coupling between the fuel production rate and the flame via the heat-feedback mechanism for candle flames, flames over solids and fuel droplet flames. Thus, to focus only on the gas-phase phenomena leading to radiative extinction, aerodynamically stabilized gaseous diffusion flames are examined. This enables independent control of the fuel flow rate to help identify conditions under which radiative extinction occurs. Also, spherical geometry is chosen for the mu-g experiments and modeling because: (1) It reduces the complexity by making the problem one-dimensional; (2) The spherical diffusion flame completely encloses the soot which is formed on the fuel rich side of the reaction zone. This increases the importance of flame radiation because now both soot and gaseous combustion products co-exist inside the high temperature spherical diffusion flame; (3) For small fuel injection velocities, as is usually the case for a pyrolyzing solid, the diffusion flame in mu-g around the solid naturally develops spherical symmetry. Thus, spherical diffusion flames are of interest to fires in mu-g and identifying conditions that lead to radiation-induced extinction is important for spacecraft fire safety.
Derived from text
Extinction; Diffusion Flames; Radiative Heat Transfer; Buoyancy; Convective Flow; Flame Propagation; Microgravity; Gravitational Effects; Drop Tests; Gaseous Diffusion; Fuel Combustion

19990053976 Russian Space Agency, Keldysh Research Center, Moscow, Russia
Preliminary Results of the Third Test Series of Nonmetal Material Flammability Evaluation In SKOROST Apparatus on the Space Station Mir
Ivanov, A. V., Russian Space Agency, Russia; Alymov, V. F., Russian Space Agency, Russia; Smirnov, A. B., Russian Space Agency, Russia; Shalayev, S. P., Russian Space Agency, Russia; Ye.Belov, D., Russian Space Agency, Russia; Balashov, Ye.V., Energiya Rocket-Space Corp., Russia; Andreeva, T. V., Energiya Rocket-Space Corp., Russia; Semenov, A. V., Energiya Rocket-Space Corp., Russia; Melikhov, A. S., Academy of Sciences (USSR), USSR; Bolodyan, I. A., Academy of Sciences (USSR), USSR; Potyakin, V. I., Academy of Sciences (USSR), USSR; Fifth International Microgravity Combustion Workshop; May 1999, pp. 47-50; In English; See also 19990053965

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The work has been done according to the US/Russian Joint Project "Experimental Evaluation of the Material Flammability in Microgravity" a continued combustion study in the SKOROST test apparatus on the OS Mir. The objective of the project was to evaluate the flammability and flame-spread rate for the selected polymer materials in low velocity flow in microgravity. Lately, the issue of nonmetal material combustion in microgravity has become of great importance, based on the necessity to develop the fire safety system for the new International Space Station (ISS). Lack of buoyant flow in microgravity reduces oxygen transfer into the combustion zone, which leads to flame extinction when the flow velocity is less than the limiting flow velocity V(sub lim) for the material. The ISS FGB fire-safety system was developed based on this phenomenon. The existence of minimum flow velocity V(sub lim) to sustain fire for the selected materials was determined both theoretically and experimentally. In the latter, it is shown that, even for thermally thin nonmetal materials with a very low oxygen index C(sub lim) of 12.5% (paper sheets with the thickness of 0.1 mm), a limiting flow velocity V(sub lim) exists at oxygen concentration Co(sub OX) = 17-21%, and is about 1.0 - 0.1 cm/sec. This might be explained by the relative increase in thermal losses due to radiation from the surface and from the gaseous phase. In the second series of experiments in Skorost apparatus on Orbital Station Mir the existence of the limiting flow velocity V(sub lim) for combustion was confirmed for PMMA and glass-epoxy composite strip samples 2 mm thick at oxygen concentration C(sub OX) = 21.5%. It was concluded that V(sub lim) depends on C(sub OX) for the PMMA sample with a low oxygen index of 15.5%, the limiting flow velocity V(sub lim) was less than 0.5 cm/sec, and for the glass-epoxy composite sample with a high oxygen index of 19%, the limiting flow velocity V(sub lim) was higher than 15 cm/sec. As of now only those materials that maintain their integrity during combustion were investigated. The materials that disintegrate when burning present more danger for fire safety because the flame can spread farther with the parts of the structure, ejected melt drops, et cetera. Materials such as polyethylene are of great interest since they form a lengthy melt zone during the combustion in normal gravity. This melt zone generates drops of liquids that promote faster flame spread compared to usual combustion. The preliminary results of polyethylene insulation flammability evaluation in microgravity are shown in the NASA Wire Insulation Flammability (WIF) experiment during Space Shuttle flight STS-50. A lot of interesting data was collected during the WIF test program. However, one of the most important results was that, in microgravity, the extinction of the polyethylene occurred almost immediately when the flow of relatively low oxygen concentration (C(sub OX)=21%) was stopped. The purpose of the work reported here is to expand the existing data base on material flammability in microgravity and to conduct the third series of the space experiment using Skorost apparatus on Orbiatl Station Mir with melting polymers, which might increase the probability of fire and its propagation in ventilated microgravity environment of orbiting spacecraft.

Derived from text

Spaceborne Experiments; Mir Space Station; Microgravity; Gravitational Effects; Flammability; Oxygen; Flow Velocity; Flame Propagation; Flame Stability; Extinction

19990053977 University of Southern California, Dept. of Aerospace and Mechanical Engineering, Los Angeles, CA USA

Studies of Premixed Laminar and Turbulent Flames at Microgravity

Abid, M., University of Southern California, USA; Aung, K., University of Southern California, USA; Ronney, P. D., University of Southern California, USA; Sharif, J. A., University of Southern California, USA; Wu, M. -S., University of Southern California, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 53-56; In English; See also 19990053965

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Several topics relating to combustion limits in premixed flames at reduced gravity have been studied. These topics include: (1) flame balls; (2) numerical simulation of flame ball and planar flame structure and stability; (3) experimental simulation of buoyancy effects in premixed flames using aqueous autocatalytic reactions; and (4) premixed flame propagation in Hele-Shaw cells.

Author

Premixed Flames; Turbulent Flames; Microgravity; Flame Stability; Computerized Simulation; Buoyancy; Gravitational Effects; Spaceborne Experiments; Flow Velocity; Flame Propagation

19990053978 NASA Glenn Research Center, Cleveland, OH USA

Gravitational Influences on Flame Propagation Through Non-Uniform Premixed Gas Systems

Miller, Fletcher J., National Center for Microgravity Research on Fluids and Combustion, USA; Easton, John, National Center for Microgravity Research on Fluids and Combustion, USA; Ross, Howard D., NASA Glenn Research Center, USA; Marchese, Anthony, Rowan Coll. of New Jersey, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 57-60; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Flame propagation through non-uniformly premixed gases occurs in several common combustion situations. As summarized in a previous conference paper, non-uniform premixed gas combustion has received scant attention compared to the more usual

limiting cases of diffusion or uniformly premixed flames. It is the goal of this research to further our knowledge of layered combustion, in which a fuel concentration gradient exists normal to the direction of flame spread, in particular by focusing on the role that gravity plays. Gravity can affect flame propagation in at least three ways: through a hydrostatic pressure gradient, by altering the initial distribution of fuel vapor, and through buoyantly induced flows once ignition has occurred. An understanding of the phenomena involved is important to fire safety, especially aboard spacecraft since no microgravity data exist. The data obtained will also be useful to verify theoretical models of this problem, which are easier to implement if buoyancy is neglected.
Derived from text
Flame Propagation; Premixed Flames; Gravitational Effects; Mathematical Models; Hydrostatic Pressure; Pressure Gradients; Fuel Combustion; Buoyancy; Microgravity; Weightlessness Simulation

19990053980 Colorado School of Mines, Center for Commercial Applications of Combustion in Space, Golden, CO USA
A Study of Flame Propagation on Water-Mist Laden Gas Mixtures in Microgravity
Abbud-Madrid, A., Colorado School of Mines, USA; Riedel, E. P., Colorado School of Mines, USA; McKinnon, J. T., Colorado School of Mines, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 65-68; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The use of water mists (very fine water sprays) for fire suppression is currently receiving increased attention as a replacement technology for halogen-based chemical agents-such as Halon 1301 (CF3Br)--the manufacturing of which has been banned by the Montreal Protocol due to their high ozone depletion potential. Water mist technology has been found effective for a wide range of applications such as Class B pool fires, shipboard machinery, aircraft cabins, computers, and electronic equipment. There are five distinct mechanisms by which water droplets may interact with a flame. First, the high enthalpy of vaporization of water (2450 kJ/kg) leads to heat removal from the flame front as the liquid droplets turn to steam. Second, as water vaporizes its volume increases approximately three orders of magnitude, which leads to the dilution of the oxygen and vaporized fuel required to maintain the flame. The third effect is the recombination of H-atoms and other radicals on the droplet surface. A fourth effect of water mists in fires is the retardation of surface propagation rates due to the wetting of walls and surfaces. The last potential impact of fine water mists affects the radiative propagation of the fire by forming an optically thick barrier to infrared radiation which prevents ignition of the unburned regions. Unfortunately, little fundamental information exists on the interaction of a flame with a water mist. to date, there is no widely accepted interpretation of the critical concentration of droplets required to suppress a flame or of the fundamental mechanisms involved in flame extinguishment by water mists. One of the main obstacles to obtaining such understanding is the difficulty of providing a simple, well-defined experimental setup for the flame front/water mist interaction. Some of the difficulty stems from the problem of generating, distributing and maintaining a homogeneous concentration of droplets throughout a chamber while gravity depletes the concentration and alters the droplet size by coalescence and agglomeration mechanisms. Experiments conducted in the absence of gravity provide an ideal environment to study the interaction of water mists and flames by eliminating these distorting effects. In addition, microgravity eliminates the complex flow patterns induced between the flame front and the water droplets. The long duration and quality of microgravity in space flights provide the required conditions to perform the setup and monitoring of flame suppression experiments. Consequently, a series of experiments have been identified to be performed on the Combustion Module (CM-2) in the Space Shuttle. These consist of measuring the extinguishing capability of a water mist on a premixed flame propagating along a tube. These experiments should provide the necessary data to obtain further understanding of the water mist suppression phenomena that can be later used to design and manufacture appropriate fire suppression systems. In preparation for the orbital flights, experiments have been conducted on low-gravity ground facilities to obtain the preliminary data necessary to define the scientific objectives and technical issues of the spacecraft experiments.
Derived from text
Flame Propagation; Gas Mixtures; Water; Mist; Extinguishing; Flame Retardants; Microgravity; Gravitational Effects; Parabolic Flight; Premixed Flames

19990053981 Hosei Univ., College of Engineering, Tokyo, Japan
Flame Investigation of Very Lean Propane-Air Mixtures Under Microgravity
Kawakami, T., Hosei Univ., Japan; Okajima, S., Hosei Univ., Japan; Sakuraya, T., Japan Space Utilization Promotion Center, Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 69-72; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Experiments on combustion of very lean mixtures in the vicinity of lower flammability limits are very important from the viewpoint of development on the combustion system for low fuel consumption and low emissions with high load engines. However, accurate data on combustion characteristics of such mixtures are scarce due to difficulties inherent in conventional measuring techniques under normal gravity. It is well known that the flame behavior is strongly influenced by buoyancy under normal gravity.

This influence is more pronounced near the lower flammability limits where flame speeds are very low. Consequently, the data such as burning velocity and flammability limits of extremely lean mixtures obtained by conventional measuring techniques under normal gravity are suspect. Thus, the present experiments have been carried out with quiescent mixtures for examining the irregular flame propagation and lower limits of flame propagation limit at very lean propane-air mixtures under microgravity. These experiments were performed in the 490 m drop shaft of the Japan Microgravity Center located in Kamisunagawa, Hokkaido, Japan.
Derived from text
Gas Mixtures; Fuel Combustion; Microgravity; Gravitational Effects; Flame Propagation; Buoyancy; Ignition Limits

19990053984 NASA Glenn Research Center, Cleveland, OH USA
Candle Flames in Microgravity
Dietrich, D. L., NASA Glenn Research Center, USA; Ross, H. D., NASA Glenn Research Center, USA; T'ien, J. S., Case Western Reserve Univ., USA; Chang, P., Case Western Reserve Univ., USA; Shu, Y., Cummins Engine Co., Inc., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 81-84; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This work is a study of a candle flame in a microgravity environment. The purpose of the work is to determine if a steady (or quasi-steady) flame can exist in a microgravity environment, study the characteristics of the steady flame, investigate the pre-extinction flame oscillations observed in a previous experiment in more detail, and finally, determine the nature of the interactions between two closely spaced candle flames. The candle flame in microgravity is used as a model of a non-propagating, steady-state, pure diffusion flame. The present work is a continuation of two small-scale, space-based experiments on candle flames, one on the Shuttle and the other on the Mir OS. The previous studies showed nearly steady dim blue flames with flame lifetimes as high as 45 minutes, and 1 Hz spontaneous flame oscillations prior to extinction. The present paper summarizes the results of the modeling efforts to date.
Author
Flames; Microgravity; Gravitational Effects; Mathematical Models; Spaceborne Experiments; Flame Stability; Computerized Simulation

19990053987 National Inst. of Standards and Technology, Building and Fire Research Lab., Gaithersburg, MD USA
Bursting Bubbles from Combustion of Thermoplastic Materials in Microgravity
Butler, K. B., National Inst. of Standards and Technology, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 93-96; In English; See also 19990053965
Contract(s)/Grant(s): NASA Order C-32033-E; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Many thermoplastic materials in common use for a wide range of applications, including spacecraft, develop bubbles internally as they burn due to chemical reactions taking place within the bulk. These bubbles grow and migrate until they burst at the surface, forceably ejecting volatile gases and, occasionally, molten fuel. In experiments in normal gravity, Kashiwagi and Ohlemiller observed vapor jets extending a few centimeters from the surface of a radiatively heated polymethylmethacrylate (PMMA) sample, with some molten material ejected into the gas phase. These physical phenomena complicated the combustion process considerably. In addition to the non-steady release of volatiles, the depth of the surface layer affected by oxygen was increased, attributed to the roughening of the surface by bursting events. The ejection of burning droplets in random directions presents a potential fire hazard unique to microgravity. In microgravity combustion experiments on nylon Velcro fasteners and on polyethylene wire insulation, the presence of bursting fuel vapor bubbles was associated with the ejection of small particles of molten fuel as well as pulsations of the flame. For the nylon fasteners, particle velocities were higher than 30 cm/sec. The droplets burned robustly until all fuel was consumed, demonstrating the potential for the spread of fire in random directions over an extended distance. The sequence of events for a bursting bubble has been photographed by Newitt et al.. As the bubble reaches the fluid surface, the outer surface forms a dome while the internal bubble pressure maintains a depression at the inner interface. Liquid drains from the dome until it breaks into a cloud of droplets on the order of a few microns in size. The bubble gases are released rapidly, generating vortices in the quiescent surroundings and transporting the tiny droplets. The depression left by the escaping gases collapses into a central jet, which rises with a high velocity and may break up, releasing one or more relatively large drops (on the order of a millimeter in these experiments). A better understanding of bubble development and bursting processes, the effects of bursting behavior on burning rate of the bulk material, and the circumstances under which large droplets are expelled, as well as their trajectories, sizes, and burning rates, is sought through computer modeling compared with experiment.
Derived from text
Bubbles; Bursts; Thermoplastic Resins; Microgravity; Chemical Reactions; Gravitational Effects; Combustion Physics; Drops (Liquids); Computerized Simulation; Mathematical Models

19990053989 Ecole Nationale Superieure de Mecanique et d'Aerotechnique, Lab. de Combustion et de Detonique, Poitiers, France

Laminar Diffusion Flames in Micro-Gravity: Experimental Results Leading to Mini-Texus-6

Vietoris, T., Ecole Nationale Superieure de Mecanique et d'Aerotechnique, France; Joulain, P., Ecole Nationale Superieure de Mecanique et d'Aerotechnique, France; Torero, J. L., Maryland Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 101-104; In English; See also 19990053965; Sponsored in part by the Minta Martin Research Foundation; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Once a fuel is ignited the flame transfers heat to the surface and the combustible material pyrolyzes providing the necessary gaseous fuel to sustain the flame, this process is commonly referred to as mass burning. In normal gravity, temperature gradients result in natural convective flows that are laminar when the scale is small, and transition to turbulence as the size of the fuel increases. In spacecraft, where buoyancy is negligible, the flow is limited to that induced by the ventilation system. Characteristic HVAC velocities are of the order of 0.1 m/s, therefore, the flow is expected to be laminar and parallel to the surface. The complex mixed flow fire scenario observed in normal gravity is reduced to a classical combustion study, "The Emmons Problem". Natural constraints imposed by buoyancy and the differences between normal gravity fires and the laminar flame studied by Emmons have prevented validation of this model. The advent of long-term space facilities motivates revisiting the work of Emmons since this configuration represents a plausible fire scenario on board of a spacecraft. Lavid and Berlad incorporated the effect of buoyancy for a horizontal plate and Fernandez-Pello and Pagni extended this analysis presenting a mixed flow parameter that applied to any orientation. Pagni and Shih used the Emmons analysis to study the flame length. All these studies relied on the assumption of infinite chemistry, none of them address the issue of stability. Theoretical work related to stability has been restricted to blow-off limits. Experimental work, using a gas burner explored the issues of stability and flow structure for velocities between 0.2 and 1.4 m/s. Hirano et al. showed an upper limit for the free stream velocity and a lower limit for the fuel injection velocity. No mention of a lower limit for the oxidizer flow is made. A study conducted by Torero et al. extended the range of velocities explored by Hirano et al. Thermal expansion and fuel injection resulted in separation of the boundary layer and the formation of 3-D flow patterns that altered the flame geometry but seemed to have only a minor stabilizing effect on the flame. Extinction at low strain rates was only observed for a minimum fuel injection velocity. The subject of flame stability under micro-gravity conditions for free stream velocities smaller than 0.2 m/s has been addressed through flame spread studies with thin fuels. Experiments with thick fuels, under these velocity regimes, are not very common since, in most cases, the micro-gravity time required is much longer than that available in ground based facilities. West et al. conducted a series of quiescent flame spread studies over thermally thick PMMA and observed that the flame spread rate decreases with time never reaching steady state conditions. The present work addresses the stability of a diffusion flame under micro-gravity conditions for free stream velocities smaller than 0.2 m/s. The fuel used is PMMA and the experiments are conducted under normal and micro-gravity conditions. Extensive ground experimentation sets the basis for the Mini-Texus-6 sounding rocket experiment.

Derived from text

Diffusion Flames; Laminar Flow; Microgravity; Buoyancy; Gravitational Effects; Rocket Sounding; Flame Stability; Flow Velocity; Free Flow; Convective Flow; Flame Propagation

19990053992 University of Southern California, Dept. of Aerospace and Mechanical Engineering, Los Angeles, CA USA

Detailed Studies on the Structure and Dynamics of Reacting Dusty Flows at Normal and Microgravity

Andac, M. Gurhan, University of Southern California, USA; Cracchiola, Brad, University of Southern California, USA; Egolfopoulos, Fokion N., University of Southern California, USA; Campbell, Charles S., University of Southern California, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 115-118; In English; See also 19990053965

Contract(s)/Grant(s): NAG3-1877; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Dusty reacting flows are of particular interest for a wide range of applications. Inert particles can alter the flammability and extinction limits of a combustible mixture. Reacting particles can release substantial amount of heat and can be used either for power generation or propulsion. Accumulation of combustible particles in air can result in explosions which, for example, can occur in grain elevators, during lumber milling and in mine galleries. Furthermore, inert particles are used as flow velocity markers in reacting flows, and their velocity is measured by non-intrusive laser diagnostic techniques. Despite their importance, dusty reacting flows have been less studied and understood compared to gas phase as well as sprays. The addition of solid particles in a flowing gas stream can lead to strong couplings between the two phases, which can be of dynamic, thermal, and chemical nature. The dynamic coupling between the two phases is caused by the inertia that causes the phases to move with different velocities. Furthermore, gravitational, thermophoretic, photophoretic, electrophoretic, diffusiophoretic, centrifugal, and magnetic forces can be exerted on the particles. In general, magnetic, electrophoretic, centrifugal, photophoretic, and diffusiophoretic can be neglected. On the other hand, thermophoretic forces, caused by steep temperature gradients, can be important. The gravitational forces are almost always present and can affect the dynamic response of large particles. Understanding and quantifying the chemi-

cal coupling between two phases is a challenging task. However, all reacting particles begin this process as inert particles, and they must be heated before they participate in the combustion process. Thus, one must first understand the interactions of inert particles in a combustion environment. The in-detail understanding of the dynamics and structure of dusty flows can be only advanced by considering simple flow geometries such as the opposed-jet, stagnation-type. In such configurations the imposed strain rate is well characterized, and the in-depth understanding of the details of the physico-chemical processes can be systematically obtained. A number of computational and experimental studies on spray and particle flows have been conducted in stagnation-type configurations. Numerically, the need for a hybrid Eulerian-Lagrangian approach has been identified by Continillo and Sirignano, and the use of such approach has allowed for the prediction of the phenomenon of droplet flow reversal. Gomez and Rosner have conducted a detailed study on the particle response in the opposed-jet configuration, and the particle thermophoretic diffusivities were determined experimentally. Sung, Law and co-workers have conducted numerical studies on the effect of strain rate and temperature gradients on the dynamics of inert particles, as a way of understanding potential errors in experimental LDV data that may arise from thermophoretic forces. This investigation is a combined experimental and numerical study on the details of reacting dusty flows. The specific tasks are: (1) Experimental determination of laminar flame speeds, and extinction strain rates of dusty flows at normal- and micro-gravity as functions of the particle type, particle initial diameter, particle initial number density, and gas phase chemical composition; (2) Detailed numerical simulation of the experiments. Results are compared with experiments and the adequacy of theoretical models is assessed; and (3) Provision of enhanced insight into the thermo-chemical coupling between the two phases.

Derived from text

Reacting Flow; Dust; Flow Velocity; Flame Propagation; Extinction; Strain Rate; Microgravity; Particles; Combustion Physics; Mathematical Models; Computerized Simulation; Dynamic Response

19990053993 Lodz Univ., Dept. of Heat Technology and Refrigeration, Poland

Combustion Mechanism of Dust Clouds in Microgravity

Jarosinski, Jozef, Lodz Univ., Poland; Podfilipski, Jerzy, Lodz Univ., Poland; Fifth International Microgravity Combustion Workshop; May 1999, pp. 119-122; In English; See also 19990053965

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Combustion of suspended solid particles in air is important from the point of view of explosion hazards and several areas of modern combustion technology (various combustion systems of coal, propulsion systems, etc). However, the physical mechanism of dust cloud combustion is still not well understood in comparison with a similar mechanism related to combustion of homogeneous gas mixtures. For a long time various closed vessel bombs were used to study combustion of dust mixtures, mainly by simulating the explosion conditions in accidents and by classifying the relative level of hazards of different dusts. Cognitive value of closed vessel bomb experiments was very limited and resolved itself into collection of various empirical coefficients and indexes. Empirical knowledge from closed vessel bomb experiments was compiled in a number of monographs (book of W. Baknecht is a good example). Apart from closed vessel bomb experiments, parallel investigations were carried out in search of reliable fundamental data on dust combustion. These data imitated parameters typical for homogenous gas flames, such as laminar burning velocity, minimum ignition energy, quenching distance and flame thickness. It was found in these experiments that values of measured parameters were comparable with experimental data for gas flames. Because the order of magnitude of measured dust flame parameters was the same as in gas flames, the processes controlling flame propagation in these flames should be similar. All these data support the opinion of Smoot and co-workers, who reported series parametric predictions to identify the controlling processes in premixed fine coal dust-air flame. It has been found as a result of these predictions, that the rate of flame propagation is controlled by the rate of streamwise molecular diffusion of oxygen and volatiles, together with heat conduction from the hot gas to the particles. On the other hand dust flames are very different from gas flames propagating in homogenous mixtures. Basic differences between combustion of dust clouds and homogenous gas mixtures result mainly from differences in properties of those mixtures. Dust cloud is a heterogeneous mixture. No method of dust formation can secure uniform dust concentration. Turbulence usually present in dust cloud combustion, differentiates local dust concentration, due to its vortical structure (centrifugal effect). Non-uniformity of dust concentration results in a more diffusional combustion regime. In gas flames the entire heat is released at the flame front. In dust flames, only a small part of heat is released at the front, the remaining part being released far behind it. In other words, propagation of the flame front through the dust mixture is not equivalent to release of the entire heat contained in the dust fuel. Most of the experiments on dust combustion are carried out in vessels with pneumatic dispersion systems, where turbulent mixing creates a dust-air mixture. In experiments carried out in microgravity conditions turbulent pulsations decay very fast (in similar experiments carried out, RMS velocity decreased from 10 m/s to 0.5 m/s in 0.2 s), while dust particles continue to be in suspension. In such conditions, flame propagates in quiescent mixture with very different local concentration. This would result in different local burning velocities and in diffusional combustion behind the flame front. The objective of the present work is to report an experimental comparative study on the effect of turbulence and ignition system on dust combustion in the constant

volume vessel and in open tube, provided both are in ground conditions and in a microgravity environment (created by falling assembly in the drop tower).
Derived from text
Turbulent Combustion; Dust; Microgravity; Turbulence Effects; Gravitational Effects; Heterogeneity; Combustion Physics; Ignition Systems; Flame Propagation

19990053994 McGill Univ., Dept. of Mechanical Engineering, Montreal, Quebec Canada
Laminar Dust Flames: A Program of Microgravity and Ground Based Studies at McGill
Goroshin, Sam, McGill Univ., Canada; Lee, John, McGill Univ., Canada; Fifth International Microgravity Combustion Workshop; May 1999, pp. 123-126; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Fundamental knowledge of heterogeneous combustion mechanisms is required to improve utilization of solid fuels (e.g. coal), safe handling of combustible dusts in industry, and solid propulsion systems. The objective of the McGill University research program on dust combustion is to obtain a reliable set of data on basic combustion parameters for dust suspensions (i.e. laminar burning velocity, flame structure, quenching distance, flammability limits, etc.) over a range of particle sizes, dust concentrations, and types of fuel. This set of data then permits theoretical models to be validated and, when necessary, new models to be developed to describe the detailed reaction mechanisms and transport processes. Microgravity is essential to the generation of a uniform dust suspension of arbitrary particle size and concentration. When particles with a characteristic size on the order of tens of microns are suspended, they rapidly settle in a gravitational field. to maintain a particulate in suspension for time duration adequate to carry out combustion experiments invariably requires continuous convective flow in excess of the gravitational settling velocity (which is comparable with and can even exceed the dust laminar burning velocity). This makes the experiments turbulent in nature and thus renders it impossible to study laminar dust flames. Even for small particle sizes on the order of microns, a stable laminar dust flow can be maintained only for relatively low dust concentrations at normal gravity conditions. High dust loading leads to gravitational instability of the dust cloud and to the formation of recirculation cells in the dust suspension in a confined volume, or to the rapid sedimentation of the dense dust cloud, as a whole, in an unconfined volume. Many important solid fuels such as carbon and boron also have low laminar flame speeds (of the order of several centimeters per second). Convection that occurs in combustion products due to buoyancy disrupts the low speed dust flames and makes observation of such flames at normal gravity difficult.
Derived from text
Dust; Gravitational Instability; Laminar Flow; Fuel Combustion; Microgravity; Gravitational Effects; Particulates; Flames; Heterogeneity

19990053999 Colorado School of Mines, Golden, CO USA
Combustion Synthesis of Advanced Porous Materials in Microgravity Environment
Zhang, X., Colorado School of Mines, USA; Moore, J. J., Colorado School of Mines, USA; Schowengerdt, F. D., Colorado School of Mines, USA; Johnson, D. P., Colorado School of Mines, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 145-148; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Combustion synthesis, otherwise known as self-propagating high temperature synthesis (SHS), can be used to produce engineered advanced porous material implants which offer the possibility for bone ingrowth as well as a permanent structure framework for the long-term replacement of bone defects. The primary advantage of SHS is based on its rapid kinetics and favorable energetics. The structure and properties of materials produced by SHS are strongly dependent on the combustion reaction conditions. Combustion reaction conditions such as reaction stoichiometry, particle size, green density, the presence and use of diluents or inert reactants, and pre-heating of the reactants, will affect the exothermicity of the reaction. A number of conditions must be satisfied in order to obtain high porosity materials: an optimal amount of liquid, gas and solid phases must be present in the combustion front. Therefore, a balance among these phases at the combustion front must be created by the SHS reaction to successfully engineer a bone replacement material system. Microgravity testing has extended the ability to form porous products. The convective heat transfer mechanisms which operate in normal gravity, 1 g, constrain the combustion synthesis reactions. Gravity also acts to limit the porosity which may be formed as the force of gravity serves to restrict the gas expansion and the liquid movement during reaction. Infiltration of the porous product with other phases can modify both the extent of porosity and the mechanical properties.
Derived from text
Combustion Synthesis; Porous Materials; Microgravity; Gravitational Effects

19990054001 Academy of Sciences (USSR), Inst. of Structural Macrokinetics and Materials Science, Moscow, USSR

Gasless SHS in Particle Clouds under Microgravity: Experiments Aboard the MIR Space Station

Merzhanov, A. G., Academy of Sciences (USSR), USSR; Rogachev, A. S., Academy of Sciences (USSR), USSR; Sytschev, A. E., Academy of Sciences (USSR), USSR; Fifth International Microgravity Combustion Workshop; May 1999, pp. 153-156; In English; See also 19990053965

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Self-propagating high-temperature synthesis (SHS) is some special kind of combustion in solid (powdered) mixtures that occurs in an autowave mode and yields valuable refractory compounds or materials as products. SHS is known to involve numerous physical processes, such as melting of reagents and products, spreading of melt, droplet coalescence, diffusion and convection in liquid metals and nonmetals, buoyancy of solid particles and bubbles in the melt, nucleation of solid products, crystal growth, and sample deformation. Some of these processes are affected by gravity. A few experimental works made up to date have shown notable differences between SHS process conducted under microgravity and normal conditions. For the most SHS systems, steady combustion is known to proceed even at the bulk density of charge (at normal gravity, minimum relative green density is normally about 30%). Therefore, we can also expect that combustion will continue at still lower charge density. In this work, we investigated SHS processes in the pressed samples as well as in the bulk (loose) powders. In microgravity, the bulk powder forms a cloud of free-moving suspended particles. The goals of our experiments are elucidation of the possibility of SHS in such clouds and comparative analysis of SHS products produced under normal and microgravity conditions.

Derived from text

Combustion Synthesis; Powder (Particles); Microgravity; Gravitational Effects; Spaceborne Experiments; Particle Density (Concentration)

19990054003 NASA Glenn Research Center, Cleveland, OH USA

Investigation of Diffusion Flame Tip Thermodiffusive and Hydrodynamic Instability under Microgravity Conditions

Wichman, I. S., Michigan State Univ., USA; Olson, S. L., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 163-166; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

We employ the opposed flow flame-spread configuration in order to examine flame-front instability of diffusion flames near cold, solid boundaries. The thermo-diffusive and hydrodynamic instabilities can transform an initially planar flame front into an irregularly curved, corrugated, possibly fragmented front. Under ordinary 1-g conditions, the buoyancy-induced flow masks the thermo-diffusive and hydrodynamic instabilities and produces planar flames. Such stable spreading flames have been observed for decades in laboratory experiments. Experiments in zero gravity are necessary to produce unstable flame fronts. The thermo-diffusive/hydrodynamic microgravity instability appears in diffusion flames such as, for example: the candle flame oscillations observed by Dietrich et al.; smolder instabilities on a recent Space Shuttle flight. Drs. T. Kashiwagi and S. Olson have attributed the latter to a lowered oxygen transport rate to the hot, reactive surface. Consider a burning surface near the flame extinction limit. The flow, or stretch, induced by the diffusion flame is weak, hence buoyancy plays a small role, thereby enabling previously secondary mechanisms, such as differential thermo-diffusion, to become the most important mechanisms. The flame leading edge becomes unstable; and diffusion flame breakup, oscillation, and rejoining all occur at a measurable frequency of approximately O(1 Hz). This project has only begun in January of this year, 1999. to date, there have been no flight experiments on flame spread instabilities. However, we have made numerous experiments in the NASA 2.2 and 5 second drop towers on flame spread over very thin cellulosic fuels. We have been very fortunate through a combination of factors, to be explained, to obtain some interesting, perhaps even compelling, results on diffusion flame instability in the presence of heat losses to cold surfaces.

Derived from text

Cold Surfaces; Diffusion Flames; Flame Propagation; Leading Edges; Flame Stability; Microgravity; Gravitational Effects; Flow Stability; Thermal Diffusion; Fuel Combustion

19990054008 Southwest Sciences, Inc., Santa Fe, NM USA

Quantitative Species Measurements in Microgravity Combustion Flames using Near-Infrared Diode Lasers

Silver, Joel A., Southwest Sciences, Inc., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 185-188; In English; See also 19990053965

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Understanding the physical phenomena controlling the ignition and spread of flames in microgravity has importance for space safety as well as for characterizing dynamical and chemical combustion processes which are normally masked by buoyancy and other gravity-related effects. Unfortunately, combustion is highly complicated by fluid mechanical and chemical kinetic processes, requiring the use of numerical modeling to compare with carefully designed experiments. More sophisticated diagnostic

methods are needed to provide the kind of quantitative data necessary to characterize the properties of microgravity combustion as well as provide accurate feedback to improve the predictive capabilities of the models. Diode lasers are a natural choice for use under the severe conditions of low gravity experiments. Reliable, simple solid state operation at low power satisfies the operational restrictions imposed by drop towers, aircraft and space-based studies. Modulation wavelength absorption spectroscopy (WMS) provides a means to make highly sensitive and quantitative measurements of local gas concentration and, in certain cases, temperature. With near-infrared diode lasers, detection of virtually all major combustion species with extremely rapid response time is possible in an inexpensive package. Advancements in near-infrared diode laser fabrication technology and concurrent development of optical fibers for these lasers led to their use in drop towers. Since near-infrared absorption line strengths for overtone and combination vibrational transitions are weaker than the mid-infrared fundamental bands, WMS techniques are applied to increase detection sensitivity and allow measurement of the major combustion gases. In the first microgravity species measurement, Silver et al. mounted a fiber-coupled laser at the top of the NASA 2.2-sec drop tower and piped the light through a single-mode fiber to the drop rig. A fiber splitter divided the light into eight channels that directed the laser beam across a methane or propane diffusion jet flame. The light beams were recaptured by a set of gradient index lenses, coupled back into separate fiber optic lines, and transmitted back to detectors and electronics in the instrument package. In these experiments a 6-mm od fiber cable (containing the nine optical fibers) fell with the drop rig. Using separate detection and demodulation channels, spatial and temporal (up to 20 Hz) maps of water vapor and methane concentrations were obtained at differing heights in the flames. While this apparatus was useful from a demonstration standpoint, several drawbacks needed attention before useful scientific measurements could be obtained. First, eight lines of sight are somewhat insufficient for detailing the spatial profiles of the gas. Second, multiple detection channels operating in parallel are both expensive and present a challenge for accurate calibration. As a result, a newer scanning system was developed in our first contract under this program. The primary characteristic of this system is that it contains a single detection channel and achieves ”continuous” spatial resolution by scanning the laser beam across the flame region, then directing this beam onto a single detector. Thus spatial measurements are converted to a temporal series of data. The true spatial resolution is limited only by the beam diameter and width of the sweep. In these experiments the beam is focused to about 1-mm diameter and scans across a region up to 4-cm wide.

Derived from text

Microgravity; Combustion; Quantitative Analysis; Gas Mixtures; Flame Propagation; Concentration (Composition); Semiconductor Lasers; Flame Temperature

19990054010 NASA Glenn Research Center, Cleveland, OH USA

Observations from the Microgravity Smoldering Combustion (MSC) Ultrasound Imaging System (UIS)

Walther, D.C., California Univ., USA; Fernandez-Pello, A. C., California Univ., USA; Anthenien, R. A., Air Force Research Lab., USA; Urban, D. L., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 193-196; In English; See also 19990053965

Contract(s)/Grant(s): NAG3-1252; NAG3-2026; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The Microgravity Smoldering Combustion (MSC) experiment is a study of the smolder characteristics of porous combustible materials in a microgravity environment. The objective of the study is to provide a better understanding of the controlling mechanisms of smolder, both in microgravity and normal earth gravity. Experiments have been conducted aboard the NASA Space Shuttle in the GAS-CAN, an apparatus requiring completely remote operation. Future GAS-CAN experiments will utilize an ultrasound imaging system (UIS). Thermocouples are currently used to measure temperature and reaction front velocities, but a less intrusive method is desirable, as smolder is affected by heat transfer along the thermocouple. It is expected that the UIS will eventually replace the existing array of thermocouples as a non-intrusive technique without compromising data acquisition. Smoldering is defined as a non-flaming, self-sustaining, propagating, exothermic, surface reaction, deriving its principal heat from heterogeneous oxidation of the fuel. Smolder of cable insulation is of particular concern in the space program; to date there have been a few minor incidents of overheated and charred cables and electrical components reported on Space Shuttle flights. Recently, the establishment of the International Space Station and other space facilities has increased interest in the study of smoldering in microgravity because of the need to preempt the possibility, and/or to minimize the effect of a smolder initiated fire during the operation of these facilities. The ignition and propagation of smolder are examined using both thermocouples and the UIS. The UIS has been implemented into the MSC flight hardware. The system provides information about local permeability variations within a smoldering sample, which can, in turn, be interpreted to track the propagation of the smolder reaction. The method utilizes the observation that transmission of an ultrasonic signal through a porous material increases with increasing permeability. Since a propagating smolder reaction leaves behind a char that is higher in permeability than the original (unburnt) material, ultrasonic

transmission can be employed to monitor the progress of the primary reaction front, char evolution (i.e. material left by the smolder reaction), pyrolysis, and condensation fronts.
Derived from text
Spaceborne Experiments; Gravitational Effects; Microgravity; Smoldering; Nonintrusive Measurement; Imaging Techniques; Ultrasonics; Data Acquisition

19990054012 Consiglio Nazionale delle Ricerche, Istituto Motori, Naples , Italy
Optical Diagnostic of Droplets in Microgravity
Massoli, P., Consiglio Nazionale delle Ricerche, Italy; Fifth International Microgravity Combustion Workshop; May 1999, pp. 201-204; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The study of vaporizing/burning droplets is essential for understanding the mass and heat transfer processes in combustion systems. More and more sophisticated models have been developed to describe the transport phenomena inside droplets and in the outer environment. Despite their large use, especially in complex codes, up to now their experimental validation has been extremely scarce. A severe verification of droplet models is obtained by measuring droplet properties (size, temperature, and composition) during heating-vaporization-burning process. Microgravity represents one of the most powerful tools when detailed combustion studies have to be performed. In microgravity environments the absence of buoyancy permits in many cases the reduction of three-dimensional problems to mono-dimensional ones with remarkable simplification of phenomenon complexity and thus of modeling. Droplets, in this view, represent one of the most emblematic cases. In this contribution, the application of light scattering methods to study droplets in vaporizing/burning regime will be discussed. The proposed techniques are particularly suitable to develop simple and compact equipment to study droplets in microgravity environments.
Derived from text
Vaporizing; Combustion; Drops (Liquids); Transport Properties; Temperature Measurement; Size Determination; Composition (Property); Microgravity; Light Scattering

19990054013 Howard Univ., Laser Spectroscopy Lab., Washington, DC USA
Laser Optogalvanic Spectroscopy pf Neon and Argon in a Discharge Plasma and its Significance for Microgravity Combustion
Misra, Prabhakar, Howard Univ., USA; Haridass, C., Howard Univ., USA; Major, H., Howard Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 205-208; In English; See also 19990053965
Contract(s)/Grant(s): NAG3-1677; NAGw-2950; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

A detailed study of combustion mechanisms in flames, employing laser-based diagnostics, has provided good knowledge and understanding of the physical phenomena, and led to better characterization of the dynamical and chemical combustion processes, both under low-gravity (in space) and normal gravity (in ground based facilities, e.g. drop towers). Laser induced fluorescence (LIF), laser-induced incandescence (LII) and LIF thermometry have been widely used to perform nonintrusive measurements and to better understand combustion phenomena. Laser optogalvanic (LOG) spectroscopy has well-established applications in ion mobility measurements, atomic and molecular spectroscopy, ionization rates, recombination rates, velocity measurements and as a combustion probe for trace element detection. Absorption spectra of atomic and molecular species in flames can be obtained via LOG spectroscopy by measuring the voltage and current changes induced by laser irradiation. There are different kinds of processes that contribute to a discharge current, namely: (1) electron impact ionization, (2) collisions among the excited atoms of the discharge species and (3) Penning ionization. In general, at higher discharge currents, the mechanism of electron impact ionization dominates over Penning ionization, whereby the latter is hardly noticeable. In a plasma, whenever the wavelength of a laser coincides with the absorption of an atomic or molecular species, the rate of ionization of the species momentarily increases or decreases due to laser-assisted acceleration of collisional ionization. Such a rate of change in the ionization is monitored as a variation in the transient current by inserting a high voltage electrode into the plasma. Optogalvanic spectroscopy in discharges has been useful for characterizing laser line-widths and for providing convenient calibration lines for tunable dye lasers in the ultraviolet, visible and infrared wavelength regions. Different kinds of quantitative information, such as the electron collisional ionization rate, can be extracted from the complex processes occurring within the discharge. In the optogalvanic effect (OGE), there is no problem of overlap from background emissions, and hence even weak signals can be detected with a high signal-to-noise ratio, which makes the optogalvanic effect sensitive enough to resolve vibrational changes in molecular bonds and differences in energy levels brought about by different electron spins. For calibration purposes, neon and argon gaseous discharges have been employed most extensively, because these gases are commonly used as buffer gases within hollow-cathode lamps and provide an acceptable density of calibration lines. In the present work, our main aim has been to understand the dominant physical

processes responsible for the production of the OGE signal, based on the extensive time resolved optogalvanic waveforms recorded, and also to extract quantitative information on the rates of excited state collisional processes.
Derived from text
Combustion Physics; Microgravity; Optogalvanic Spectroscopy; Plasmas (Physics); Gas Ionization; Gas Discharges; Waveforms

19990054014 Colorado Univ., Center for Combustion and Environmental Research, Boulder, CO USA
Combustion of Metals in Reduced-Gravity and Extraterrestrial Environment
Abbud-Madrid, A., Colorado Univ., USA; Omaly, P., Colorado Univ., USA; Branch, M. C., Colorado Univ., USA; Daily, J. W., Colorado Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 211-215; In English; See also 19990053965
Contract(s)/Grant(s): NAG3-2220; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

As a result of the ongoing exploration of Mars and the several unmanned and manned missions planned for the future, increased attention has been given to the use of the natural resources of the planet for rocket propellant production and energy generation. Since the atmosphere of Mars consists of approximately 95% carbon dioxide (CO2), this gas is the resource of choice to be employed for these purposes. Unfortunately, CO2 is also a final product in most combustion reactions, requiring further processing to extract useful reactants such as carbon monoxide (CO), oxygen (O2), and hydrocarbons. An exception is the use of CO2 as an oxidizer reacting directly with metal fuel. Since many metals burn vigorously with CO2, these may be used as an energy source and as propellants for an ascent/descent vehicle in sample-collection missions on Mars. In response to NASA's Human Exploration and Development of Space (HEDS) Enterprise to search for appropriate in-situ resource utilization techniques, this investigation will study the burning characteristics of promising metal/CO2 combinations. The use of reduced gravity is essential to eliminate the intrusive buoyant flows that plague the high-temperature metal reactions, to remove the destructive effect of gravity on the shape of molten metal samples, and to study the influence of radiative heat transfer from solid oxides undisturbed by natural convection. In studies with large metal specimens, the burning process is invariably influenced by strong convective currents that accelerate the reaction and shorten the burning times. Although these currents are nearly absent from small burning particles, the high emissivity of the flames, rapid reaction, small length scales, and intermittent explosions make the gathering of any useful information on burning rates and flame structure very difficult. This investigation has the ultimate goal of providing a careful probing of flame structure and dynamics by taking advantage of large, free-floating spherical metal samples and their corresponding long burning times available in reduced gravity. The first set of experiments has been conducted with magnesium (Mg) samples burning in the low-gravity environment generated by an aircraft flying parabolic trajectories. Owing to its high adiabatic flame temperature, oxidizer/fuel ratio, and heat per unit mass of fuel, as well as its low toxicity and low ignition temperature, Mg has been identified as a promising metal fuel with CO2 as oxidizer. The experimental effort is complemented by the development of a numerical model combining gas-phase chemical kinetics and transport mechanisms.
Derived from text
Metal Combustion; Carbon Dioxide; Gas-Metal Interactions; Metal Fuels; Gravitational Effects; Microgravity; Extraterrestrial Environments; Mathematical Models; Magnesium; Flame Stability; Flame Propagation

19990054015 Titan Corp., AeroChem Research Lab., Princeton, NJ USA
Combustion of Aerosolized Metal Particles in Microgravity
Dreizin, E. L., Titan Corp., USA; Berman, C. H., Titan Corp., USA; Hoffman, V. K., Titan Corp., USA; Vicenzi, E. P., Princeton Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 215-218; In English; See also 19990053965
Contract(s)/Grant(s): NAS3-96017; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The combustion behavior and interaction effects of multiple metal particles are addressed in this project. The microgravity environment presents a unique opportunity to create an "aerosol" consisting of relatively large, 50-300 micron diameter particles, so that both cloud flame structure and individual particle combustion behavior can be characterized simultaneously. The microgravity experiments are conducted using the 2.2 s NASA Lewis Research Center drop tower. Each test includes aerosolizing metal particles under microgravity, a delay required to produce a steady aerosol, and igniting such an "aerosol" at constant pressure using a hot wire igniter. The flame structure and details of individual particle combustion are visualized using both high speed movie and regular speed video cameras. Combustion products are collected and analyzed after the experiment. A detailed description of the experimental apparatus is given elsewhere. Microgravity experiments with magnesium particle aerosols have been conducted and experiments with zirconium particles are currently in progress. A numerical, time dependent model of the flame propagation in magnesium aerosol is being developed.
Derived from text
Metal Combustion; Metal Particles; Flame Propagation; Microgravity; Gravitational Effects; Aerosols; Magnesium

19990054017 Semenov (N. N.) Inst. for Chemical Physics, Moscow, Russia

Gravity Effect in Aluminum Droplet Ignition and Combustion

Assovskiy, I. G., Semenov (N. N.) Inst. for Chemical Physics, Russia; Zhigalina, O. M., Semenov (N. N.) Inst. for Chemical Physics, Russia; Kuzhnetsov, G. P., Semenov (N. N.) Inst. for Chemical Physics, Russia; Kolesnikov-Svinarev, V. I., Semenov (N. N.) Inst. for Chemical Physics, Russia; Fifth International Microgravity Combustion Workshop; May 1999, pp. 223-226; In English; See also 19990053965

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A distinguishing feature of aluminum combustion is formation of condensed products. Despite great significance of this process for many applications (from ceramic to dust formation in cosmos), there is not any commonly accepted theoretical model of this process. First, it is due to the difficulties of experimental investigation. These difficulties are associated with high values of temperature and concentrations gradients around burning particles that restrict application of the standard methods for diagnostics of chemical reactions. Additional difficulties are associated with free and induced convection complicating the streamline flow around the burning particle. To overcome these problems, an advanced experimental technique was used in this study. It allows one to determine the thermal structure of reaction zones and the products morphology at various moments of particle's ignition and combustion. This technique uses a special installation for multi-parametrical study of single particle combustion in low gravity environments. There are several reasons to investigate droplet's ignition and combustion in the low- or microgravity environment. First, the microgravity gives a unique opportunity to avoid non-regular disturbances introduced in the combustion process by free convection. Such conditions, assumed in many theories, could provide a correct comparison of theoretical and experimental data. Second, preliminary experiments have shown that morphology of condensed phases of combustion products depends significantly on gravity level and other characteristics of oxidizing gas-mixture. That is why the emphasis in this study is on morphology of combustion products and their dependence on combustion conditions. The morphology characteristics of condensed phase of combustion products have been determined in normal and low gravity environment using the scanning and transmission electron microscopy. Peculiar clusters and longitudinal macro-aggregates of spherical microparticles have been found in the products of low-gravity combustion under high-pressure. Correlation between geometrical characteristics of these aggregates and pressure of oxidizing environment has been found.

Derived from text

Combustion Products; Convective Flow; Drops (Liquids); Free Convection; Gravitational Effects; Metal Combustion; Microgravity; Microparticles; Morphology

19990054019 Virginia Univ., Mechanical and Aerospace Engineering, Charlottesville, VA USA

Heterogeneous Combustion of Porous Graphite Particles in Normal and Microgravity

Chelliah, Harsha, Virginia Univ., USA; Miller, Fletcher, National Center for Microgravity Research on Fluids and Combustion, USA; Pantano, David, Virginia Univ., USA; Kasimov, Aslan, Virginia Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 233-236; In English; See also 19990053965

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Combustion of solid fuel particles has many important applications, including power generation and space propulsion systems. The current models available for describing the combustion process of these particles, especially porous solid particles, include various simplifying approximations. One of the most limiting approximations is the lumping of the physical properties of the porous fuel with the heterogeneous chemical reaction rate constants. The primary objective of the present work is to develop a rigorous model that could decouple such physical and chemical effects from the global heterogeneous reaction rates. For the purpose of validating this model, experiments with porous graphite particles of varying sizes and porosity are being performed at NASA Lewis Research Center. The details of the experimental and theoretical model development effort are described.

Derived from text

Graphite; Mathematical Models; Microgravity; Fuel Combustion; Metal Particles; Gravitational Effects; Porous Materials

19990054020 California Univ., MAE Dept., Davis, CA USA

Combustion of Two-Component Miscible Droplets in Reduced Gravity

Shaw, B. D., California Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 237-240; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

This paper presents recent theoretical and experimental results from an ongoing research program that deals with reduced-gravity combustion of bi-component droplets initially in the mm size range or larger. The primary objectives of the research are to study the effects of droplet internal flows, thermal and solutal Marangoni stresses, and species volatility differences on liquid species transport and overall combustion phenomena (e.g., gas-phase unsteadiness, burning rates, sooting, radiation, and extinction). The research program utilizes a reduced-gravity environment so that buoyancy effects are rendered negligible. Use of large

droplets also facilitates visualization of droplet internal flows, which is important to this research. This program is a continuation of extensive ground based experimental and theoretical research on bi-component droplet combustion which has been ongoing for several years. The focal point of this research program is a flight experiment (Bi-Component Droplet Combustion Experiment, BCDCE). This flight experiment is still under development. However, supporting ground studies have been performed, and preliminary data have been obtained from flight experiments (Fiber Supported Droplet Combustion Experiment, FSDC-1 and FSDC-2). These flight experiments were performed during the STS-73/USML-2 and STS-94/MSL- I missions. In the experiments, droplets composed of low- and high-volatility species are burned. The low-volatility components are initially present in small amounts. As combustion of a droplet proceeds, the liquid surface mass fraction of the low-volatility component will increase with time, resulting in a sudden and temporary decrease in droplet burning rates as the droplet rapidly heats to temperatures close to the boiling point of the low-volatility component. This decrease in burning rates causes a sudden and temporary contraction of the flame. The decrease in burning rates and the flame contraction can be observed experimentally. Measurements of burning rates as well as the onset time for flame contraction allow effective liquid-phase species diffusivities to be calculated, e.g., using asymptotic theory. A goal of the research is to relate effective liquid species diffusivities to droplet internal flow characteristics. Droplet internal flows will be visualized in future flight and ground-based experiments.
Derived from text
Drops (Liquids); Hydrocarbon Combustion; Internal Flow; Microgravity; Gravitational Effects; Flame Propagation; Spaceborne Experiments; Burning Rate; Thermal Stresses; Flame Stability

19990054021 Illinois Univ., Dept. of Mechanical Engineering, Chicago, IL USA
Experiments and Model Development for the Investigation of Sooting and Radiation Effects in Microgravity Droplet Combustion
Manzello, Samuel L., Illinois Univ., USA; Hua, Ming, Illinois Univ., USA; Choi, Mun Y., Illinois Univ., USA; Dryer, Frederick L., Princeton Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 241-244; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Combustion of fossil fuels represents a significant portion of the energy consumption in the world. For example, in 1997, the equivalent of 1,800 million tons of oil was consumed in the USA. This staggering number, which represents 25% of the total world consumption, illustrates the need not only for conservation, but for promoting efficiency in required uses. Another consideration of equal importance is the impact of combustion on the environment. Most practical energy conversion processes involve introduction of liquid fuels into an oxidizing environment in the form of sprays that are comprised of droplets burning in isolation or in groups. Empirical engineering approaches to advancing combustion system design must be computationally assisted if we are to make significant improvements while meeting more demanding emissions constraints in the future. However, theoretical/computational developments and experimental validation of spray combustion remains a daunting task due to the complex coupling of a turbulent, two-phase flow with phase change and chemical reactions. Individual droplet behavior (including ignition, evaporation and combustion) has long been recognized as an important component for developing a better understanding of the more complex spray combustion processes. Since the early 1950's, the burning of an isolated droplet has been theoretically analyzed in a spherically-symmetric configuration involving coupling of chemical reactions and two-phase flow with phase change. Since then, the simple 'd-squared-law' analysis using an infinite reaction rate producing a thin flame has been superceded by fully-transient computational models that describe the evolution of 50 chemical species using nearly 300 reversible reactions in the gas-phase and detailed transport coupling in the liquid-phase. This level of description is required since new generations of time-dependent computational tools must embody compact, but realistic sub-models that accurately represent the properties and coupling of fluid dynamics, diffusive processes, heat transfer, and combustion. New computational tools based upon direct numerical simulation and other methods hold promise for modeling multi-dimensional reacting systems. Computational resource limitations and a desire to perform parametric calculations require that these tools utilize reduced representations of parameters including degree of asymmetry and the scope of the description of chemical kinetics and other sub-model components. Unidimensional, time-dependent, laminar, non-premixed combustion problems are critical to developing, testing, validating and systematically reducing sub-models to produce descriptions that can be used in more applied computations. The scientific objectives of this effort are to elucidate the unresolved issues related to sooting and accompanying radiation effects in the simple, spherically-symmetric configuration of isolated droplet burning in microgravity.
Derived from text
Combustion Physics; Drops (Liquids); Mathematical Models; Microgravity; Radiation Effects; Soot; Gravitational Effects; Burning Rate; Flames

19990054022 Cornell Univ., Ithaca, NY USA

Experimental Study of Nonane and Nonane/Hexanol Fuel Droplet Combustion in Microgravity

Avedisian, C. T., Cornell Univ., USA; Callahan, B. J., Cornell Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 245-248; In English; See also 19990053965

Contract(s)/Grant(s): NAG3-1791; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

In this presentation we review experiments carried out on nonane droplets, and a nonane/hexanol droplet, burning in microgravity to promote spherical symmetry. The nonane/hexanol combination was selected for the following reasons: 1) the spherically symmetric burning history of nonane and nonane/hexanol mixtures has not been previously studied; 2) measurements of the burning history of pure nonane droplets in air extend the existing data base of spherical droplet flames of soot-producing fuels which are useful for testing detailed chemical kinetic models of the spherically symmetric droplet burning process; 3) nonane and hexanol have almost identical boiling points so heterogeneous nucleation on a support fiber is unlikely; 4) hexanol does not have a strong propensity for water vapor absorption; 5) hexanol produces less soot than nonane so that mixtures of nonane and hexanol should show an effect of composition on soot formation. The far-field gas was atmospheric pressure air at room temperature. The evolution of droplet diameter was measured using high speed cine photography of spark-ignited droplets within a confined volume in a drop tower. The importance of soot formation during droplet combustion is derived from the fact that soot is the basic component of the particulate emission process that occurs in spray combustion. The complexity of soot formation motivates a one-dimensional transport condition which is advantageous for modeling. Recent numerical studies of droplet combustion have assumed spherical symmetry when incorporating such aspects as detailed chemistry and radiation, though soot formation itself has not yet been included in any droplet combustion modeling effort. If radiation is not important as would be the case for'small' droplets (i.e., droplets with initial diameters less than about]mm), soot formation can lead to a nonlinear burning process and a time-varying burning rate, (non-linear burning of a non-sooting fuel like methanol is due to water vapor absorption on the droplet. The classical quasi-steady droplet burning theory predicts a linear evolution of droplet diameter in scaled coordinates for any fuel type.

Derived from text

Combustion Chemistry; Drops (Liquids); Fuel Combustion; Microgravity; Nonanes; Soot; Gravitational Effects; Burning Rate

19990054023 Nihon Univ., Dept. of Aerospace Engineering, Funabashi, Japan

Influence of Acoustic Field on Droplet Combustion in Microgravity

Tanabe, M., Nihon Univ., Japan; Aoki, K., Nihon Univ., Japan; Sato, K., Ishikawajima-Harima Heavy Industries Co. Ltd., Japan; Fujimori, T., Ishikawajima-Harima Heavy Industries Co. Ltd., Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 249-252; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Combustion of an isolated fuel droplet in an acoustic field is investigated by microgravity experiments. The influence of acoustic field is examined by varying sound pressure level and frequency of sound. Configuration of flames and soot and burning rate is determined. As a result, hemispheric and conical flames are observed under the presence of sound depending on the sound pressure level. Ring-shaped soot coagulation (soot-ring) is observed as well for a moderate loudness of sound. Burning rate is significantly enhanced by sound and this is clarified to be able to explain by the enhancement mass/heat transfer by convection induced by the sound.

Author

Drops (Liquids); Combustion Physics; Acoustics; Burning Rate; Gravitational Effects; Microgravity; Soot; Sound Waves; Flames

19990054024 NASA Glenn Research Center, Cleveland, OH USA

Vortex/Flame Interactions in Microgravity Pulsed Jet Diffusion Flames

Bahadori, M. Y., Science and Technology Development Corp., USA; Hegde, U., National Center for Microgravity Research on Fluids and Combustion, USA; Stocker, D. P., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 255-258; In English; See also 19990053965

Contract(s)/Grant(s): NAS3-98031; NCC3-544; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The problem of vortex/flame interaction is of fundamental importance to turbulent combustion. These interactions have been studied in normal gravity. It was found that due to the interactions between the imposed disturbances and buoyancy induced instabilities, several overall length scales dominated the flame. The problem of multiple scales does not exist in microgravity for a pulsed laminar flame, since there are no buoyancy induced instabilities. The absence of buoyant convection therefore provides an environment to study the role of vortices interacting with flames in a controlled manner. There are strong similarities between imposed and naturally occurring perturbations, since both can be described by the same spatial instability theory. Hence, imposing a harmonic disturbance on a microgravity laminar flame creates effects similar to those occurring naturally in transitional/turbu-

lent diffusion flames observed in microgravity. In this study, controlled, large-scale, axisymmetric vortices are imposed on a microgravity laminar diffusion flame. The experimental results and predictions from a numerical model of transient jet diffusion flames are presented and the characteristics of pulsed flame are described.
Author
Diffusion Flames; Flame Propagation; Microgravity; Turbulent Combustion; Vortices; Gravitational Effects; Laminar Flow; Spaceborne Experiments

19990054025 NASA Glenn Research Center, Cleveland, OH USA
Characteristics of Non-Premixed Turbulent Flames in Microgravity
Hegde, U., National Center for Microgravity Research on Fluids and Combustion, USA; Yuan, Z. G., National Center for Microgravity Research on Fluids and Combustion, USA; Stocker, D. P., NASA Glenn Research Center, USA; Bahadori, M. Y., Science and Technology Development Corp., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 259-262; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The momentum of the fuel (and/or air) jet is important in classifying gas-jet diffusion flame behavior. Normal-gravity data on gas-jet flames show that the flame height (non-dimensionalized with respect to an effective diameter) can be correlated to a density weighted Froude number in the buoyancy-dominated limit. In the momentum-dominated limit this non-dimensional flame height asymptotes to a constant value. The momentum-dominated limit under normal gravity conditions is usually obtained for very high injection velocities which in turn results in high values of the injection Reynolds number. This results in a complicated flame structure because of the large number of turbulence scales involved. In order to gain better insight into the structure of these flames it would be useful to reduce the injection Reynolds number while still maintaining turbulent conditions. This can be done in microgravity where momentum-dominated turbulent flames are obtained at much smaller velocities than in normal gravity. In this paper, experimental results on the effects of nozzle diameter and fuel dilution on flame height are discussed. The experimental values are compared with predictions from a numerical procedure utilizing the standard k-epsilon turbulence model. Flame height scaling with nozzle size and dilution is established. Differences between model predictions and measurements are presented. In order to explain these differences, evolutions of turbulent spectra and Taylor microscale along the flame axis are considered.
Derived from text
Diffusion Flames; Dilution; Microgravity; Momentum; Turbulent Flames; Fuel Combustion; Flame Propagation; Gravitational Effects; Nozzle Flow

19990054027 Michigan Univ., Dept. of Aerospace Engineering, Ann Arbor, MI USA
Flame-Vortex Interactions in Microgravity to Improve Models of Turbulent Combustion
Driscoll, James F., Michigan Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 267-270; In English; See also 19990053965
Contract(s)/Grant(s): NAG3-1639; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

A unique flame-vortex interaction experiment is being operated in microgravity in order to obtain fundamental data to assess the Theory of Flame Stretch which will be used to improve models of turbulent combustion. The experiment provides visual images of the physical process by which an individual eddy in a turbulent flow increases the flame surface area, changes the local flame propagation speed, and can extinguish the reaction. The high quality microgravity images provide benchmark data that are free from buoyancy effects. Results are used to assess Direct Numerical Simulations of Dr. K. Kailasanath at NRL, which were run for the same conditions.
Derived from text
Flame Propagation; Microgravity; Computerized Simulation; Turbulent Combustion; Vortices; Gravitational Effects; Mathematical Models

19990054028 Michigan Univ., Lab. for Turbulence and Combustion, Ann Arbor, MI USA
The Interaction of a Vortex Ring with a Diffusion Flame Under Microgravity Conditions
Chen, Shin-Juh, Michigan Univ., USA; Dahm, Werner J. A., Michigan Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 271-274; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Turbulent diffusion flames represent by far the largest class of combustion problems, with applications ranging from aerospace propulsion systems, to industrial combustion processes, and to utility power generation systems. Direct investigation of turbulent flame processes to identify the fundamental effects of elementary flow, transport, and combustion phenomena can be difficult. Flame-vortex interactions provide a way to isolate these fundamental elements and study them under carefully controllable conditions. The flame-vortex configuration used in this study allows direct study of many of these phenomena, but has not

previously been accessible to experiments owing to the fact that such investigations can only be conducted under microgravity conditions as shown by Chen & Dahm (1996, 1997). Limiting theoretical analyses by Karagozian & Manda (1986) and Manda & Karagozian (1988) for the corresponding two-dimensional problem allow comparisons, as do recent direct numerical simulations by James & Madna (1996). Here we present results revealing effects of heat release and radiation on the combustion process. Author

Diffusion Flames; Vortex Rings; Flame Propagation; Microgravity; Turbulent Flames; Combustion Physics; Turbulence Effects; Fuel Combustion

19990054030 NASA Glenn Research Center, Cleveland, OH USA

Combustion of Interacting Droplet Arrays in a Microgravity Environment

Dietrich, D. L., NASA Glenn Research Center, USA; Struk, P. M., National Center for Microgravity Research on Fluids and Combustion, USA; Kitano, K., Hokkaido National Industrial Research Inst., Japan; Ikegami, M., Hokkaido National Industrial Research Inst., Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 281-284; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Investigations into droplet interactions date back to Rex et al. Recently, Annamalai and Ryan and Annamalai published extensive reviews of droplet array and cloud combustion studies. The authors studied the change in the burning rate constant, k, (relative to that of the single droplet) that results from interactions. Under certain conditions, there exists a separation distance where the droplet lifetime reaches a minimum, or average burning rate constant is a maximum . Additionally, since inter-droplet separation distance, L, increases relative to the droplet size, D, as the burning proceeds, the burning rate is not constant throughout the burn, but changes continuously with time. Only Law and co-workers and Mikami et al. studied interactions under conditions where buoyant forces were negligible. Comparing their results with existing theory, Law and co-workers found that theory over predicted the persistency and intensity of droplet interactions. The droplet interactions also depended on the initial array configuration as well as the instantaneous array configuration. They also concluded that droplet heating was retarded due to interactions and that the burning process did not follow the ”D-squared” law. Mikami et al. studied the combustion of a two-droplet array of heptane burning in air at one atm pressure in microgravity. They showed that the instantaneous burning rate constant increases throughout the droplet lifetime, even for a single droplet. Also, the burn time of the array reached a minimum at a critical inter-droplet spacing. In this article, we examine droplet interactions in normal and microgravity environments. The microgravity experiments were in the NASA GRC 2.2 and 5.2 second drop towers, and the JAMIC (Japan Microgravity Center) 10 second drop tower. Special emphasis is directed to combustion under conditions that yield finite extinction diameters, and to determine how droplet interactions affect the extinction process.

Derived from text

Burning Rate; Combustion Physics; Drops (Liquids); Microgravity; Reaction Kinetics; Gravitational Effects; Gas-Liquid Interactions

19990054031 Drexel Univ., Mechanical Engineering and Mechanics Dept., Philadelphia, PA USA

Formation and Levitation of Unconfined Droplet Clusters

Liu, S., Drexel Univ., USA; Ruff, G. A., Drexel Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 285-288; In English; See also 19990053965

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Combustion experiments using arrays of droplets seek to provide a link between single droplet combustion phenomena and the behavior of complex spray combustion systems. Both single droplet and droplet array studies have been conducted in microgravity to better isolate the droplet interaction phenomena and eliminate or reduce the confounding effects of buoyancy-induced convection. In most experiments involving droplet arrays, the droplets are supported on fibers to keep them stationary and close together before the combustion event. The presence of the fiber, however, disturbs the combustion process by introducing a source of heat transfer and asymmetry into the configuration. As the number of drops in a droplet array increases, supporting the drops on fibers becomes less practical because of the cumulative effect of the fibers on the combustion process. The overall objective of this research is to study the combustion of well-characterized drop clusters in a microgravity environment. Direct experimental observations and measurements of the combustion of droplet clusters would fill a large gap in our current understanding of droplet and spray combustion and provide unique experimental data for the verification and improvement of spray combustion models. This paper describes current work on the design and performance of an apparatus to generate and stabilize droplet clusters using acoustic and electrostatic forces.

Author

Drops (Liquids); Clusters; Electrostatics; Acoustic Levitation

19990054032 Nihon Univ., College of Industrial Technology, Narashino, Japan

Microgravity Experiments on Combustion of Monodispersed and Mono-Sized Fuel Droplet Clouds

Nomura, H., Nihon Univ., Japan; Koyama, M., Nihon Univ., Japan; Ujiie, Y., Nihon Univ., Japan; Sato, J., Ishikawajima-Harima Heavy Industries Co. Ltd., Japan; Yoda, S., National Space Development Agency, Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 289-293; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Monodispersed and mono-sized droplet clouds as a simple model of sprays have been applied to fundamental studies on spray combustion by some researchers. Burgoyne and Cohen, Mizutani and Ogasawara and Hayashi and coworkers investigated mainly flammability limits of droplet clouds. They used droplet clouds falling down in a combustion tube. Hayashi and Kumagai investigated flame propagation in stationary droplet clouds. to realize uniform and stationary droplet clouds, they developed a rapid expansion apparatus, which was based on the principle of Wilson's cloud chamber. They used small droplet clouds for experiments because large droplets fell down during the generation process of droplet clouds. In the present work, flame propagation in fuel droplet clouds was studied experimentally with a rapid expansion apparatus. To prevent droplets from falling down by gravity, for large droplet clouds, experiments were performed under microgravity conditions. A new type of rapid expansion apparatus was developed for microgravity experiments.

Derived from text

Microgravity; Gravitational Effects; Fuel Sprays; Cloud Chambers; Combustion Physics; Fuel Combustion; Flame Propagation

19990054035 Osaka Prefecture Univ., Sakai, Japan

Autoignition of a Fuel Droplet in Supercritical Gaseous Environments under Microgravity in a Drop Shaft

Kadota, Toshikazu, Osaka Prefecture Univ., Japan; Nakainkyo, Akira, Osaka Prefecture Univ., Japan; Hirota, Shuichi, Osaka Prefecture Univ., Japan; Segawa, Daisuke, Osaka Prefecture Univ., Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 303-306; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The operating pressure in the combustion chamber of internal combustion engines which use liquid fuel spray has increased, and often exceeded the thermodynamic critical pressure of the liquid fuel of frequent utilization for the higher thermal efficiency and higher rate of heat release. In such conditions, the liquid fuel droplets are allowed to burn in the gaseous environments of which temperature and pressure exceed the critical conditions of the liquid fuel. In spite of the extensive efforts, there is still lack of knowledge on the combustion of a fuel droplet in supercritical gaseous environments. This has caused us to be involved in a series of a research programs designed for obtaining the detailed information leading to the deep understanding of the combustion phenomena of fuel droplets in supercritical gaseous environments under microgravity. The first phase of the experimental study has been done on the combustion of a fuel droplet under microgravity during the parabolic flight of aircraft. Photographic observation was made of a fuel droplet evaporating inside a luminous sooting flame which was subjected to the backward irradiation of an intensive laser light. This resulted in the determination of the time histories of the droplet diameter and hence the burning rate constant. Also measured were the ignition delay, the burning life time and the flame diameter.

Derived from text

Burning Rate; Combustion Physics; Critical Pressure; Drops (Liquids); Fuel Sprays; Microgravity; Spontaneous Combustion; Fuel Combustion; Flame Propagation

19990054036 Korea Advanced Inst. of Science and Technology, Taejon, Korea, Republic of

Microgravity Experiment on Flame Spread of a Fuel Droplet Array in a High-Pressure Environment

Park, J., Korea Advanced Inst. of Science and Technology, Korea, Republic of; Iwahashi, T., Tohoku Univ., Japan; Kobayashi, H., Tohoku Univ., Japan; Niioka, T., Tohoku Univ., Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 307-310; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The researches on flame spread of a droplet array are useful for understanding the fundamental mechanism of spray combustion. However, the flame size of a suspended single droplet is more than 1.0 mm and a spreading flame of a fuel droplet array is much larger than the single droplet flame, so that natural convection extensively affects the flame spread phenomenon especially in a high-pressure environment. In this study, flame spread experiments of a n-decane droplet array were conducted over the wide pressure range from ordinary pressure to supercritical pressures of the fuel in microgravity to eliminate the natural convection. Flame spread rates were measured by OH emission images recorded by an intensified high-speed video. High-speed Schlieren observations were also conducted and flame spread characteristics around the critical pressure without natural convection were discussed.

Derived from text

Flame Propagation; Drops (Liquids); Supercritical Pressures; Fuel Combustion; Gravitational Effects; Microgravity; Hydrocarbon Combustion

19990054037 Centre National de la Recherche Scientifique, Lab. de Combustion et Systemes Reactifs, Orleans, France

Effects of Gravitational Acceleration on High Pressure Combustion of Methanol Droplets

Chauveau, C., Centre National de la Recherche Scientifique, France; Vieille, B., Centre National de la Recherche Scientifique, France; Goekalp, I., Centre National de la Recherche Scientifique, France; Segawa, D., Osaka Prefecture Univ., Japan; Kadota, T,, Osaka Prefecture Univ., Japan; Nakainkyo, A., Osaka Prefecture Univ., Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 311-314; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

A Franco-Japanese cooperative research program on microgravity combustion has been initiated since 1996; part of this program is devoted to understand the combustion processes of methanol droplets under high pressure conditions. Methanol is considered to be one of the most promising candidates as alternative fuel for several applications. Also, the operating pressures in the combustion chamber of liquid fueled internal combustion engines are increasing for higher thermal efficiency. Liquid fuel droplets burn therefore in high pressure gaseous environments and the ambient pressure often exceeds the critical pressure of the fuel. A review of the literature indicates that the combustion characteristics of fuel droplets burning in high-pressure gaseous environments remain largely unexplored. For example, it was found experimentally under microgravity conditions and theoretically that the burning rate of various fuels shows a maximum around the critical pressure. However, the burning rates obtained in a recent experiment under microgravity conditions did not show a peak around the critical pressure. The difficulty in the experiments on droplet combustion arises from the combustion generated buoyant flow in normal gravity, which is enhanced in high-pressure gaseous environments. The reduced surface tension of the droplet burning in high-pressure gaseous environments does not allow the use of the well-known suspended droplet technique in normal gravity. Microgravity conditions offer therefore the opportunity to perform droplet combustion experiments in an environment free from the effect of gravity induced natural convection. The primary objective of our study is to obtain the detailed information needed for the understanding of the combustion process of a single methanol droplet in high-pressure gaseous environments. The present paper describes recent results on the combustion of a methanol droplet under variable ambient pressures and gravitational accelerations. The experiments were conducted under normal gravity, and under microgravity with the use of the parabolic flights of the CNES A300 airplane in France and the drop shaft at JAMIC in Japan.

Derived from text

Gravitational Effects; Microgravity; Methyl Alcohol; Fuel Combustion; Critical Pressure; Drops (Liquids); Pressure Effects; Burning Rate; Combustion Physics

19990054042 NASA Glenn Research Center, Cleveland, OH USA

Ignition, Transition, Flame Spread in Multidimensional Configurations in Microgravity

Kashiwagi, Takashi, National Inst. of Standards and Technology, USA; Mell, William E., National Inst. of Standards and Technology, USA; Baum, Howard R., National Inst. of Standards and Technology, USA; Olson, Sandra, NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 333-336; In English; See also 19990053965

Contract(s)/Grant(s): NASA Order C-32001-R; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

In the inhabited quarters of orbiting spacecraft, fire is a greatly feared hazard. Thus, the fire safety strategy in a spacecraft is (1) to keep any fire as small as possible, (2) to detect any fire as early as possible, and (3) to extinguish any fire as quickly as possible. This suggests that a material which undergoes a momentary ignition might be tolerable but a material which permits a transition from a localized ignition to flame spread would significantly increase the fire hazard in a spacecraft. If the transition does not take place, fire growth does not occur. Therefore, it is critical to understand what process controls the transition. Many previous works have studied ignition and flame spread separately or were limited to a two-dimensional configuration. In this study, time-dependent phenomena of the transition over a thermally thin sample is studied experimentally and theoretically in two- and three-dimensional (2D,3D) configurations. Furthermore, localized ignition can be initiated at the center portion of thermally thin paper sample instead of at one end of the sample. Thus, the transition to flame spread could occur either toward upstream or downstream or both directions simultaneously with an external flow. In this presentation, the difference in the transition between the 3D and 2D configurations is explained with the numerically calculated data. For sufficiently narrow samples edge effects exist. Some results on this issue are presented. New analysis of the surface smoldering experiments conducted in the space shuttle STS-75 flight is also described.

Derived from text

Ignition; Flame Propagation; Microgravity; Mathematical Models; Smoldering

19990054043 University of Southern California, Dept. of Aerospace and Mechanical Engineering, Los Angeles, CA USA

Transport and Chemical Effects on Concurrent and Opposed-Flow Flame Spread at Microgravity

Honda, L. K., University of Southern California, USA; Ronney, P. D., University of Southern California, USA; Fifth International

Microgravity Combustion Workshop; May 1999, pp. 337-340; In English; See also 19990053965
Contract(s)/Grant(s): NCC3-671; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

With support from a previous NASA grant, NAG3-161 1, the PI studied the effects of diluent type, the addition of sub-flammability-limit concentrations of combustible gases, and the effects of concurrent buoyant flow on flame spread processes. The results of these studies are reported and directions for the current grant outlined. Most experiments were conducted in a 20 liter combustion chamber. Exactly the same apparatus was used for 1 g and microgravity tests. The effect of inert gases He, Ar, N2, CO2 and SF6 on flame spread were tested since they provide a variety of radiative properties and oxygen Lewis numbers. CO and CH4 were used for the gaseous fuels in partially-premixed atmosphere tests, plus H2, C3H8 and NH3 for 1 g tests only. In most experiments 5 cm wide Kimwipe samples 15 cm long were used and were held by aluminum quenching plates. The samples were ignited by an electrically-heated Kanthal wire. The flame spread process was imaged via three video cameras and a laser shearing interferometer.

Derived from text

Combustion Physics; Transport Properties; Flame Propagation; Chemical Effects; Microgravity

19990054044 Hokkaido Univ., Dept. of Mechanical Science, Sapporo, Japan

Observation of Flame Spread along Solid Fuel Particle Array in Microgravity: Effect of Surrounding Gas Condition

Fujita, Osamu, Hokkaido Univ., Japan; Ito, Kenichi, Hokkaido Univ., Japan; Nogami, Manami, Hokkaido Univ., Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 341-344; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

In fuel particle cloud combustion such as spray or pulverized coal combustion individual particle burns with spherical flame because the particle size is small enough to neglect the effect of buoyancy. However, as each particle is too small it is difficult to observe the combustion phenomena. Even if simulation of the fine particle combustion with larger size particle is tried, the effect of buoyancy becomes significant because of the larger Grashof number with larger size. Therefore, the use of microgravity environment is quite effective to do the simulation experiments. For this reason many experiments on fuel droplet combustion have been performed in microgravity. Single droplet, interference of fuel particle flames, and flame spreading over fuel droplet array. However, experiment on flame spreading over solid particle array in microgravity is limited. The flame spread over solid particle array can be a simulation of flame spreading of spray combustion of high boiling point fuel or the pulverized coal combustion, in which the evolution process of volatile matter is dominant for the flame propagation. In the previous research the flame spreading over foamed polystyrene particle array have been investigated to know the effect of surrounding gas condition such as O2 concentration and inert dilution gas as well as particle spacing on the flame spreading phenomena. In the present work the effect of pressure in the range of 0.25 to 2.5 atm have mainly been discussed in comparison with the effect of the parameters reported in the previous work.

Derived from text

Flame Propagation; Fuel Combustion; Microgravity; Pressure Effects; Combustion Physics; Polystyrene

19990054045 Hokkaido Univ., Dept. of Mechanical Engineering, Sapporo, Japan

Combustion of 2-Dimensionally Arranged Fuel Samples Under Microgravity Conditions

Nagata, H., Hokkaido Univ., Japan; Nakamura, S., Hokkaido Univ., Japan; Kudo, I., Hokkaido Univ., Japan; Ito, K., Hokkaido Univ., Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 345-348; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

In the combustors of jet engines or rocket engines, fuel droplets burn in droplet clouds and their combustion mechanism is different from that of single droplets because of the interaction between the droplets. Two droplet combustion and droplet array combustion have been studied experimentally to investigate the basic mechanism of the interaction. These simple arrangements are effective to improve basic understandings of group combustion from the microscopic viewpoint. To understand the interaction from the macroscopic viewpoint, on the other hand, it is desirable to observe burning droplets which are arranged two or three dimensionally. It is a promising method to simulate group combustion by placing some spherical fuel samples that are large enough to afford easy arrangement and observation. When the fuel sample's size is large, however, the effect of natural convection increases, modifying the combustion field. to eliminate the effect of natural convection, the authors employed microgravity environment. Butanol and hexanol are employed as fuels and they are mixed into polyethylene-glycol to make them solid state in room temperature. This treatment enables us easy set up of initial sample diameter and sample arrangement. Group combustion is simulated with large fuel samples arranged 2-dimensionally. Effects of sample space on flame shape and droplet life time are investigated experimentally.

Derived from text

Drops (Liquids); Microgravity; Fuel Combustion; Flame Propagation

19990054048 All-Russian Inst. for Fire Safety, Moscow, Russia

The Study of Polymer Material Combustion in Simulated Microgravity by Physical Modeling Method

Melikhov, A. S., All-Russian Inst. for Fire Safety, Russia; Bolodyan, I. A., All-Russian Inst. for Fire Safety, Russia; Potyakin, V. I., All-Russian Inst. for Fire Safety, Russia; Ivanov, A. V., Academy of Sciences (USSR), USSR; Alymov, V. F., Academy of Sciences (USSR), USSR; Smirnov, A. B., Academy of Sciences (USSR), USSR; Belov, D. Y., Academy of Sciences (USSR), USSR; Balashov, Y. V., RSC-Energia, Russia; Andreeva, T. V., RSC-Energia, Russia; Fifth International Microgravity Combustion Workshop; May 1999, pp. 361-364; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The tendency in space-mission development is that as overall spacecraft mass decreases, the use of polymer material increases. These materials as a part of the structure and hardware present the primary flammable payload of the spacecraft. In the oxygen enhanced environment of spacecraft, the danger of a fire becomes real. In order to ensure fire safety, researchers in many countries are evaluating material flammability in microgravity. Unique data were collected to describe material flammability in microgravity, and new flammability parameters were identified. The material combustion at its limit is characterized by the limiting flow velocity (V(sub lim)) which is required to sustain a fire in microgravity, and by the level of microgravity (g(sub lim)) itself. These parameters appeared to depend on oxygen concentration (C(sub ox)) in the environment, and the quantitative dependency was recovered. The physical parameters described above are essential to characterize flammability of the material in space and thus to promote fire safety. It is extremely difficult and expensive to conduct experiments in real microgravity (in the drop tower; in the airplane, flying along a parabolic trajectory; on the space station). Therefore, it became advantageous to develop new methods to evaluate material combustion and ignition in the ground environment with suppressed convection. A specific method was developed that makes it possible to create a physical model of polymer material ignition and combustion in simulated microgravity. This method is based on material flammability evaluation in the flat moving layer of gaseous media that contains oxygen (the Narrow Channel apparatus). The gaseous media flows between two parallel horizontal plates, that are closely spaced and heavy enough to maintain a uniform wall temperature. The sample of the evaluated material is positioned along the longitudinal axis of the apparatus on the end of the holder, which is operated by the drive mechanism. The gas mixture of prescribed (C(sub ox)) is blended and then flows through the channel. Flow velocity setting for the test is based on previously obtained results of flow calibration using smoke visualization technique. The work presents some of the results of Narrow Channel testing compared to the results of space experiment in Skorost test apparatus on Orbital Station Mir in 1998.

Derived from text

Flammability; Polymers; Microgravity; Space Environment Simulation; Flow Velocity; Flame Propagation; Polyethylenes

19990054053 Southwest Sciences, Inc., Santa Fe, NM USA

A Compact, Tunable Near-UV Source for Quantitative Microgravity Combustion Diagnostics

Peterson, K. A., Southwest Sciences, Inc., USA; Oh, D. B., Southwest Sciences, Inc., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 381-384; In English; See also 19990053965

Contract(s)/Grant(s): NAS3-98044; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

There is a need for improved optical diagnostic methods for use in microgravity combustion research. Spectroscopic methods with fast time response that can provide absolute concentrations and concentration profiles of important chemical species in flames are needed to facilitate the understanding of combustion kinetics in microgravity. Although a variety of sophisticated laser-based diagnostics (such as planar laser induced fluorescence, degenerate four wave mixing and coherent Raman methods) have been applied to the study of combustion in laboratory flames, the instrumentation associated with these methods is not well suited to microgravity drop tower or space station platforms. Important attributes of diagnostic systems for such applications include compact size, low power consumption, ruggedness, and reliability. We describe a diode laser-based near-UV source designed with the constraints of microgravity research in mind. Coherent light near 420 nm is generated by frequency doubling in a nonlinear crystal. This light source is single mode with a very narrow bandwidth suitable for gas phase diagnostics, can be tuned over several 1/cm and can be wavelength modulated at up to MHz frequencies. We demonstrate the usefulness of this source for combustion diagnostics by measuring CH radical concentration profiles in an atmospheric pressure laboratory flame. The radical concentrations are measured using wavelength modulation spectroscopy (WMS) to obtain the line-of-sight integrated absorption for different paths through the flame. Laser induced fluorescence (LIF) measurements are also demonstrated with this instrument, showing the feasibility of simultaneous WMS absorption and LIF measurements with the same light source. LIF detection perpendicular to the laser beam can be used to map relative species densities along the line-of-sight while the integrated absorption available through WMS provides a mathematical constraint on the extraction of quantitative information from the LIF data. Combining absorption with LIF - espe-

cially if the measurements are made simultaneously with the same excitation beam - may allow elimination of geometrical factors and effects of intensity fluctuations (common difficulties with the analysis of LIF data) from the analysis.
Derived from text
Ultraviolet Lasers; Radiation Sources; Light Sources; Laser Induced Fluorescence; Combustion Physics; Absorption Spectroscopy

19990054055 NASA Glenn Research Center, Cleveland, OH USA
Particle-Image Velocimetry in Microgravity Laminar Jet Diffusion Flames
Sunderland, P. B., NASA Glenn Research Center, USA; Greenberg, P. S., NASA Glenn Research Center, USA; Urban, D. L., NASA Glenn Research Center, USA; Wernet, M. P., NASA Glenn Research Center, USA; Yanis, W., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 389-392; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

This paper discusses planned velocity measurements in microgravity laminar jet diffusion flames. These measurements will be conducted using Particle-Image Velocimetry (PIV) in the NASA Glenn 2.2-second drop tower. The observations are of fundamental interest and may ultimately lead to improved efficiency and decreased emissions from practical combustors. The velocity measurements will support the evaluation of analytical and numerical combustion models. There is strong motivation for the proposed microgravity flame configuration. Laminar jet flames are fundamental to combustion and their study has contributed to myriad advances in combustion science, including the development of theoretical, computational and diagnostic combustion tools. Nonbuoyant laminar jet flames are pertinent to the turbulent flames of more practical interest via the laminar flamelet concept. The influence of gravity on these flames is deleterious: it complicates theoretical and numerical modeling, introduces hydrodynamic instabilities, decreases length scales and spatial resolution, and limits the variability of residence time. Whereas many normal-gravity laminar jet diffusion flames have been thoroughly examined (including measurements of velocities, temperatures, compositions, sooting behavior and emissive and absorptive properties), measurements in microgravity gas-jet flames have been less complete and, notably, have included only cursory velocity measurements. It is envisioned that our velocity measurements will fill an important gap in the understanding of nonbuoyant laminar jet flames.
Derived from text
Particle Image Velocimetry; Diffusion Flames; Gas Jets; Velocity Measurement; Microgravity; Flow Velocity

19990054059 Yale Univ., Dept. of Mechanical Engineering, New Haven, CT USA
Computational and Experimental Study of Energetic Material in a Counterflow Microgravity Environment
Smooke, Mitchell D., Yale Univ., USA; Yetter, R. A., Princeton Univ., USA; Parr, T. P., Naval Air Warfare Center, USA; Hanson-Parr, D. M., Naval Air Warfare Center, USA; Tanoff, M. A., W. K. Kellogg Inst., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 407-410; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Ground based (normal gravity) combustion studies can provide important information on the processes by which monopropellants and composite systems burn. The effects of gravitational forces, however, can often complicate the interpretation of the models and the implementation of experiments designed to help elucidate complex issues. We propose to utilize a combined computational/experimental approach in a microgravity environment to understand the interaction of oxidizer-binder diffusion flames in composite propellants. By operating under microgravity conditions we will be able to increase the length scales and suppress the gravitational forces on melting binders such that increased resolution of both major and minor species will be possible thus reducing the demands placed on both the computational and diagnostic tools. Results of a detailed transport/finite rate chemistry model will be compared with nonintrusive optical diagnostic measurements of the structure and extinction of diffusion flames in which oxidizers such as ammonium perchlorate (AP) and ammonium dinitramide (ADN) are counterflowed against realistic binders such as hydroxyl-terminated polybutadiene (HTPB) and 3,3-bis(azidomethyl)oxetane (BAMO). The work proposed herein represents a collaborative effort among the research groups at Yale University, Princeton University and the Combustion Diagnostics Laboratory at the Naval Air Warfare Center in China Lake, CA.
Derived from text
Monopropellants; Composite Propellants; Solid Rocket Propellants; Propellant Combustion; Microgravity; Counterflow; Mathematical Models

19990054060 TDA Research, Inc., Wheat Ridge, CO USA

Formation of Carbon Nanotubes in a Microgravity Environment

Alford, J. M., TDA Research, Inc., USA; Diener, M. D., TDA Research, Inc., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 413-416; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Nanotube science has become one of the worlds most rapidly advancing areas of research. However, most investigations have concentrated on determining the physical properties of the tubes; very little is known about the fundamental processes involved in nanotube formation. The gas phase process for single-walled nanotube formation is very similar to many sooting combustion processes and most of the fundamental kinetic and transport processes involved are expected to be similar. by eliminating the uncontrolled effects of buoyancy, we believe that microgravity experiments could substantially increase the fundamental knowledge of nanotube formation and lead to the development of both better nanotubes and production processes. The scientific objective of this investigation is to determine how microgravity processing can improve the production and morphology (size and length) of single-walled carbon nanotubes (SWNTs).

Derived from text

Combustion Physics; Gravitational Effects; Microgravity; Nanostructure (Characteristics); Synthesis (Chemistry)

19990054062 Notre Dame Univ., Dept. of Chemical Engineering, IN USA

The Effects of Gravity on Combustion and Structure Formation During Synthesis of Advanced Materials

Varma, A., Notre Dame Univ., USA; Pelekh, A., Notre Dame Univ., USA; Mukasyan, A., Notre Dame Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 421-424; In English; See also 19990053965

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Combustion in a variety of heterogeneous systems, leading to the synthesis of advanced materials, is characterized by high temperatures (2000-3500 K) and heating rates (up to 10(exp 6) K/s) at and ahead of the reaction front. These high temperatures generate liquids and gases which are subject to gravity-driven flow. The removal of such gravitational effects is likely to provide increased control of the reaction front, with a consequent improvement in control of the microstructure of the synthesized products. Thus, microgravity experiments can lead to major advances in the understanding of fundamental aspects of combustion and structure formation under the extreme conditions of the combustion synthesis wave. In addition, the specific features of microgravity environment allow one to produce unique materials, which cannot be obtained under terrestrial conditions. The general goals of the current research are: 1) to improve the understanding of fundamental phenomena taking place during combustion of heterogeneous systems, 2) to use low-gravity experiments for insight into the physics and chemistry of materials synthesis processes, and 3) based on the obtained knowledge, to optimize processing conditions for synthesis of advanced materials with desired microstructures and properties. This research follows logically from the results of investigations we have conducted in the framework of our previous grant on gravity influence on combustion synthesis (CS) of gasless systems. Prior work, by others and by us, has clearly demonstrated that gravity plays an important role during combustion synthesis of materials. The immediate tasks for the future are to quantitatively identify the nature of observed effects, and to create accurate local kinetic models of the processes, which can lead to a control of the microstructure and properties of the synthesized materials. In summary, this is the value of the proposed research. Based on our prior work, we focus on the fundamental aspects of combustion and structure formation under the unique condition of microgravity.

Derived from text

Combustion Synthesis; Gravitational Effects; Heterogeneity; Microgravity

19990054064 Maryland Univ., Dept. of Mechanical Engineering, College Park, MD USA

Studies on the Behavior of Highly Preheated Air Flames in Microgravity

Gupta, Ashwani K., Maryland Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 431-432; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche; Abstract Only; Abstract Only

This study is directed at examining the global flame behavior of highly preheated air flames under microgravity conditions using methane, ethane and propane as the fuels. Specific focus will be on determining the global flame features, time resolved spatial emission of OH, CH and C2 from flames, spatial distribution of flame flicker, flame radiation and spatial distribution of temperature (using micro-thermocouples and optical pyrometer) and vibrational temperature (calculated by comparing two different C2 bands) as affected by microgravity, combustion air preheat temperature, fuel type and flame equivalence ratio. Highly preheated air combustion is extremely important in practice as it can reduce fuel consumption by up to about 30%, reduce the equipment size, and reduce pollutants emission (including NOX and CO2) by about 20-30% without any adverse effect on thermal loading or performance of the system. In order to explore the potential of highly preheated low oxygen concentration air combustion we propose to examine the fundamental differences in the behavior of these flames at normal and microgravity conditions

as compared to the flames obtained with normal temperature air or slightly preheated air. The flowing gas mixture of N2 and O2 at room temperature will be preheated to any temperature up to about 1200 deg C in an experimental facility. This degree of air preheat in the furnace is commensurable with that used in many regenerative furnaces. The fuel maintained at near room temperature, will be injected into the combustion chamber. The facility will allow controlled variation of the air preheat temperature, fuel type, injector geometry, O2 concentration in air and mixture stoichiometry in the test section of the combustion chamber. The test section will be optically accessible for providing the desired optical diagnostics of the flames. The methane fuel simulates well the behavior of natural gas fueled flames while propane fuel simulates LPG and most liquid fueled flames without the added complexity of droplet formation and evaporation. The choice of ethane fuel is due to the availability of flame behavior with normal air at room temperature under microgravity conditions, in addition to the role of type of hydrocarbon fuel. Flame plume behavior is available with the above three fuels at reduced gravity using normal room temperature air. We propose to examine the flame behavior with unheated, moderately heated and highly preheated air having normal (21% oxygen) and low oxygen concentration (down to about 2%) at microgravity conditions. Specific measurements to be made here at normal or microgravity conditions include: flame size and shape, vibrational flame temperature, time resolved spatial emission of OH, CH and C2, spatial distribution of flame flicker and flame heat flux. This data will then be analyzed to determine the role of microgravity on the flame behavior. The systematic data to be obtained here will allow most desirable flame characteristics to be achieved with a given fuel at any equivalence ratio, including the case of ultra fuel-lean combustion conditions. In some applications high flame radiations are important while in others a blue flame is desired. Our studies will provide means of controlling the flame signatures and flame radiation in addition to providing a database for model validation and model development.
Derived from text

Flames; Flame Propagation; Flame Temperature; Fuel Combustion; Combustion Temperature; Combustion Chambers; Microgravity; Gravitational Effects

19990054065 Princeton Univ., Dept. of Mechanical and Aerospace Engineering, NJ USA

Near-Limit, High-Pressure Spherical Flame Propagation in Microgravity

Law, C. K., Princeton Univ., USA; Tse, S. D., Princeton Univ., USA; Zhu, D. L., Princeton Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 433-436; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Recognizing that combustion processes within internal combustion engines take place in elevated pressure environments, that most fundamental information on the aerothermochemistry of flames were obtained at substantially lower pressures, and that the chemical reaction mechanisms which govern the various flame processes are inherently nonlinear which can cause non-monotonic variations of the combustion responses with pressure, the proposed program aims to obtain fundamental understanding and useful data on flame propagation, extinction, and stability, and to assist in the compilation of comprehensive reaction mechanisms applicable to pressures up to 60 atmospheres. The vehicle of study is the spark-ignited outwardly-propagating spherical flame in a pressurized environment. The need to conduct the experiment in microgravity arises from the interest in limit phenomena especially those associated with ultra-lean combustion, and the observation that buoyancy tends to significantly distort the flame from spherical symmetry for weakly-burning flames in elevated pressure environments. The proposed program on near-limit and limit phenomena at elevated pressures consists of the following inter-related projects, each with its own focus and objectives: (1) Determination of the laminar flame speeds of conventional gaseous fuels by experimentally measuring the stretch-affected propagation speeds of the spherical flame and systematically subtracting out the stretch effect. (2) Determination of the corresponding Markstein times which represent the flame responsivity to influences of aerodynamic stretching and mixture nonequidiffusion. (3) Determination of the extinction limits of these aerodynamically-stretched flames, and computational assessment of the role of radiative loss in extinction and the possible extension of the fundamental flammability limits by stretch. (4) Investigation of the characteristics of the Landau-Darrieus and diffusional-thermal flamefront instabilities, including their interactions and the influence of flame wrinkling on the flame propagation rate. (5) Re-compilation of existing chemical kinetic mechanisms by using the high-pressure flame speed data as optimization points, so as to extend their applicability to higher pressure ranges. The experiment, initially to be conducted in the drop tower, will involve optical imaging of the expanding flamefront, from which the instantaneous flame speed and stretch rate can be determined when the flame is smooth, and the nature of flamefront instability can be studied when it is wrinkled. From these data, the laminar flame speeds, the Markstein times, and the extinction states can be determined. Re-compilation of the chemical kinetic mechanism will adopt state-of- the-art optimization technique. Computational simulation and analytical modeling using detailed/simplified chemistry and transport will also be conducted, in parallel with the

experimentation, in order to identify the controlling diffusive and chemical kinetic processes and factors which influence the various combustion responses.
Derived from text
Aerothermochemistry; Diffusivity; Extinction; Flame Propagation; Flames; Gaseous Fuels; Mathematical Models; Microgravity; Reaction Kinetics; Thermal Instability; Fuel Combustion; Gravitational Effects

19990054066 Illinois Univ., Dept. of Mechanical Engineering, Chicago, IL USA
Gravity Effects on Partially Premixed Flames
Puri, Ishwar K., Illinois Univ., USA; Aggarwal, Suresh K., Illinois Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 437-440; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Partially premixed flames can be established by design by placing a fuel-rich mixture in contact with a fuel-lean mixture, but these flames also occur otherwise in many practical systems. For instance, initially nonpremixed combustion may involve regions of local extinction followed by partial premixing and re-ignition. Likewise, partial premixing is an important process in non-premixed flame liftoff phenomena, since the reactants can mix slightly prior to ignition. Nonuniform evaporation in spray flames can also result in local fuel-rich regions in which burning occurs in the partially premixed mode and the technique of lean direct injection used to achieve stable combustion and reduced pollutant levels involves regions of partially-premixed combustion. In addition, unwanted fires can originate in a partially premixed mode when a pyrolyzed or evaporated fuel forms an initial fuel-rich mixture with the ambient air. Under normal-gravity conditions the flame heat release produces both flow dilatation and buoyancy effects in partially pre-mixed flames. Gas expansion due to the heating causes downstream motion normal to the flamefront. The buoyant gases accelerate the flow in an opposite direction to the gravity vector, causing air entrainment that enhances the fuel-air mixing and, consequently, influences the upstream region. While it is possible to minimize gravitational effects in a premixed flame by isolating buoyancy effects to the lower-density post-flame region or plume, it is not so straightforward to do so in nonpremixed flames. Several investigations have established that partially premixed flames can contain two (even, three) reaction zones, one with a premixed-like structure and the other consisting of a transport-limited nonpremixed zone (in which mixing and entrainment effects are significant). For these reasons it is important to understand the interaction between flow dilatation and buoyancy effects in partially premixed flames. This investigation compares the results obtained from numerical computations of two-dimensional partially premixed methane-air flames established under both normal and zero gravity conditions. This investigation pertains to partially premixed flames established on a rectangular Wolfbard-Parker slot burner that is schematically depicted. A fuel-rich mixture is introduced from the inner slot, and air from either side of it. Identical two-dimensional flames are established on either side of the centerline. The combustion process is simulated by employing a detailed numerical model based on the solution of time-dependent governing equations for a two-dimensional reacting flow. A relatively detailed 17-species, 52-step C1-mechanism is used to represent the CH4-air chemistry.
Derived from text
Air Flow; Buoyancy; Gravitational Effects; Premixed Flames; Two Dimensional Flow; Fuel Combustion

19990054069 State Univ. of New York, Dept. of Mechanical and Aerospace Engineering, Buffalo, NY USA
Large Eddy Simulation of Gravitational Effects on Transitional and Turbulent Gas-Jet Diffusion Flames
Gicquel, L. Y. M., State Univ. of New York, USA; Jaberi, F. A., State Univ. of New York, USA; Givi, P., State Univ. of New York, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 451-454; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The objective of this work is to assess the influence of gravity on the compositional and the spatial structures of transitional and turbulent hydrocarbon flames with nonpremixed reactants. This is an entirely ground-based research in which we plan to utilize a recently developed methodology termed the ”filtered mass density function” (FMDF) for large eddy simulation (LES) of turbulent reactive flows. The novelty of the methodology is that it allows for ”reliable” LES of turbulent flames at a small fraction of the computational cost of direct numerical simulation (DNS). It also allows for inclusion of ”realistic physics;” this has been difficult in the majority of previous contributions via DNS. Moreover, it facilitates detailed analysis of the compositional structure and the evolution of the flame which are not possible via ”Reynolds averaged simulation” (RAS). The flow configuration is that of a gas-jet in which a fuel is issued from a jet into a coflowing (or stagnant) stream of an oxidizer. The importance of buoyancy in such a diffusion flame is well recognized. However, presently there are very few large scale computational strategies which can include all of the important physical intricacies of turbulent combustion in this configuration. The LES/FMDF methodology will be used in conjunction with realistic representations of the chemical kinetics effects; thus replicating a ”genuine” flame via numerical simulations. The simulated results will be utilized for: (i) capturing the unsteady evolution of the flame and the influence of buoyancy-induced flow on the ”spatial” flame structure, (ii) determining the statistical flame behavior at varying gravity levels

and orientations, (iii) elucidating the ”compositional structure” of the flame at microgravity, and (iv) analyses of the data set recently made available by the Microgravity Science and Application Division of the NASA Headquarters.
Derived from text
Large Eddy Simulation; Gravitational Effects; Turbulent Flames; Turbulent Combustion; Gas Jets; Jet Flow; Computerized Simulation; Diffusion Flames

19990054070 NASA Glenn Research Center, Cleveland, OH USA
An Experiment Investigation of Fully-Modulated, Turbulent Diffusion Flames in Reduced Gravity
Hermanson, J. C., Worcester Polytechnic Inst., USA; Johari, H., Worcester Polytechnic Inst., USA; Usowicz, J. E., Worcester Polytechnic Inst., USA; Stocker, D. P., NASA Glenn Research Center, USA; Nagashima, T., Tokyo Univ., Japan; Obata, S., National Defense Academy, Japan; Fifth International Microgravity Combustion Workshop; May 1999, pp. 455-458; In English; See also 19990053965
Contract(s)/Grant(s): NCC3-673; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Pulsed combustion appears to have the potential to provide for rapid fuel/air mixing, compact and economical combustors, and reduced exhaust emissions. The ultimate objective of this program is to increase the fundamental understanding of the fuel/air mixing and combustion behavior of pulsed, turbulent diffusion flames by conducting experiments in microgravity. In this research the fuel jet is fully-modulated (i.e., completely shut off between pulses) by an externally controlled valve system. This can give rise to drastic modification of the combustion and flow characteristics of flames, leading to enhanced fuel/air mixing mechanisms not operative for the case of acoustically excited or partially-modulated jets. In addition, the fully-modulated injection approach avoids the strong acoustic forcing present in pulsed combustion devices, significantly simplifying the mixing and combustion processes. Relatively little is known of the behavior of turbulent flames in reduced-gravity conditions, even in the absence of pulsing. The goal of this Flight-Definition experiment (PUFF, for PUlsed-Fully Flames) is to establish the behavior of fully-modulated, turbulent diffusion flames under microgravity conditions. Fundamental issues to be addressed in this experiment include the mechanisms responsible for the flame length decrease for fully-modulated, turbulent diffusion flames compared with steady flames, the impact of buoyancy on the mixing and combustion characteristics of these flames, and the characteristics of turbulent flame puffs under fully momentum-dominated conditions.
Derived from text
Diffusion Flames; Turbulent Flames; Microgravity; Gravitational Effects; Fuel Combustion; Turbulent Mixing; Jet Flow; Pulses

19990054073 California Univ., Dept. of Mechanical and Aerospace Engineering, Los Angeles, CA USA
Acoustically Forced, Condensed Phase Fuel Combustion Under Microgravity Conditions
Smith, O. I., California Univ., USA; Karagozian, A. R., California Univ., USA; Kim, H. -C., California Univ., USA; Ghenai, C., California Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 469-472; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The focus of this project is on understanding and quantifying the effects of external acoustical perturbations on combustion of condensed fuels under microgravity conditions. The issue of acoustic excitation of flames in microgravity is especially pertinent to understanding the behavior of accidental fires which could occur in spacecraft crew quarters and which could be affected by pressure perturbations as result from ventilation fans or engine vibrations. While in normal gravity, studies have long shown that there can be a significant increase in fundamental reaction and transport processes with the imposition of an external acoustical field, under reduced gravity, the elimination of natural convection means the effect of acoustic excitation could be far more pronounced on flame behavior. Experiments as well as numerical computations will be performed in this study. The geometry of the combusting fuel droplet has been selected. While it is widely recognized that single droplet combustion is a problem well suited for fundamental microgravity studies, the spherical geometry here is selected purely for experimental and numerical convenience. We plan to examine combustion of very large droplets, such that curvature effects are relatively unimportant. Hence we expect the results of this study to apply as well to condensed fuel combustion in other geometries.
Derived from text
Acoustic Excitation; Drop Size; Drops (Liquids); Fuel Combustion; Microgravity; Gravitational Effects

19990054074 NASA Glenn Research Center, Cleveland, OH USA
Effects of Structure and Hydrodynamics on the Sooting Behavior of Spherical Microgravity Diffusion Flames
Sunderland, P. B., NASA Glenn Research Center, USA; Axelbaum, R. L., Washington Univ., USA; Urban, D. L., NASA Glenn Research Center, USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 475-478; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Recent experimental, numerical and analytical work has shown that the stoichiometric mixture fraction (Z(sub st)) can have a profound effect on soot formation in diffusion flames. These findings were obtained at constant flame temperature (T(sub ad)), employing the approach described in Du and Axelbaum (1995, 1996). For example, a fuel mixture containing 1 mole of ethylene and 11.28 moles of nitrogen burning in pure oxygen ((Z(sub st)) = 0.78) has the same adiabatic flame temperature (2370 K) as that of pure ethylene burning in air ((Z(sub st)) = 0.064). An important finding of these works was that at sufficiently high (Z(sub st)), flames remain blue as strain rate approaches zero in counterflow flames, or as flame height and residence time approach infinity in coflowing flames. Lin and Faeth (1996a) coined the term permanently blue to describe such flames. Two theories have been proposed to explain the appearance of permanently-blue flames at high (Z(sub st)). They are based on (1) hydrodynamics and (2) flame structure. Previous experimental studies in normal gravity are not definitive as to which, if either, mechanism is dominant because both hydrodynamics and structure suppress soot formation at high (Z(sub st)) in coflowing and counterflowing diffusion flames. In counterflow flames with (Z(sub st)) is less than 0.5 streamlines at the flame sheet are directed toward the fuel. Newly formed soot is convected into richer regions, favoring soot growth over oxidation. For (Z(sub st)) is greater than 0.5, convection at the flame is toward the oxidizer, thus enhancing soot oxidization. Thus, in counterflow flames, hydrodynamics causes soot to be convected towards the oxidizer at high (Z(sub st)) which suppresses soot formation. Axelbaum and co-workers maintain that while the direction of convection can impact soot growth and oxidation, these processes alone cannot cause permanently-blue flames. Soot growth and oxidation are dependent on the existence of soot particles and the presence of soot is invariably accompanied by yellow luminosity. Soot-particle inception, on the other hand, arises from gas-phase reactions and its dependence on flow direction is weak, similar to that of other gas-phase reactions in flames. For example, when the flame moves across the stagnation plane no significant changes in flame chemistry are observed. Furthermore, since the soot-inception zone has a finite thickness, soot has been produced in counterflow flames with (Z(sub st)) is greater than 0.5. For large (Z(sub st)) the fuel concentration decreases and oxygen concentration increases in the soot forming regions of the flame. This yields a shift in the OH profile toward the fuel side of the flame, and this shift can dramatically influence soot inception because it essentially narrows the soot inception zone. Soot-free (permanently-blue) conditions can be realized when the structure of the flame is adjusted to the extent that significant oxidizing species exist on the fuel side of the flame at temperatures above the critical temperature for soot inception, ca. 1250 K. In previously considered flames it was impossible to independently vary flame structure and convection direction. In contrast, spherical diffusion flames (which generally require microgravity) allow both properties to be varied independently. We altered structure (Z(sub st)) by exchanging inert between the oxidizer and the fuel and we independently varied convection direction at the flame sheet by interchanging the injected and ambient gases. In this work we established four flames: (a) ethylene issuing into air, (b) diluted ethylene issuing into oxygen, (c) air issuing into ethylene, and (d) oxygen issuing into diluted ethylene. (Z(sub st)) is 0.064 in flames (a) and (c) and 0.78 in flames (b) and (d). The convection direction is from fuel to oxidizer in flames (a) and (b) and from oxidizer to fuel in flames (c) and (d). Under the assumption of equal diffusivities of all species and heat, the stoichiometric contours of these flames have identical temperatures and nitrogen concentrations.
Derived from text
Soot; Microgravity; Diffusion Flames; Hydrodynamics; Fuel Combustion

19990054082 Academia Sinica, Inst. of Engineering Thermophysics, Beijing, China
A Study of Candle Flame in Microgravity
Zhang, X. G., Academia Sinica, China; Du, W. F., Academia Sinica, China; Wei, M. G., Academia Sinica, China; Kong, W. J., Academia Sinica, China; Hua, Y., Academia Sinica, China; Fifth International Microgravity Combustion Workshop; May 1999, pp. 509-512; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Candle flame is one of the most interesting topics in microgravity combustion and has been extensively studied to illustrate the characteristics of a non-propagating, steady-state, pure diffusion flame. Many important results were obtained, such as flame shape, size, color and structure that are quite different in microgravity from those in normal gravity . Candle flame in normal gravity is tear-drop-like shape and bright yellow color, however in microgravity it becomes spherical (or hemispherical) and dim blue respectively. In order to have further information of these differences, a series of experiments have been conducted in the existing drop tower at National Microgravity Laboratory (NML), Chinese Academy of Sciences (CAS). Some of the experimental observations will be presented here briefly.
Derived from text
Diffusion Flames; Drop Towers; Gravitation; Microgravity

19990054083 California Univ., Mechanical and Aerospace Engineering, Irvine, CA USA
Electrical Aspects of Flames in Microgravity Combustion
Dunn-Rankin, D., California Univ., USA; Strayer, B., California Univ., USA; Weinberg, F., Imperial Coll. of Science Technology and Medicine, UK; Carleton, F., Imperial Coll. of Science Technology and Medicine, UK; Fifth International Microgravity Com-

bustion Workshop; May 1999, pp. 515-518; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

A principal characteristic of combustion in microgravity is the absence of buoyancy driven flows. In some cases, such as for spherically symmetrical droplet burning, the absence of buoyancy is desirable for matching analytical treatments with experiments. In other cases, however, it can be more valuable to arbitrarily control the flame's convective environment independent of the environmental gravitational condition. to accomplish this, we propose the use of ion generated winds driven by electric fields to control local convection of flames. Such control can produce reduced buoyancy (effectively zero buoyancy) conditions in the laboratory in 1-g facilitating a wide range of laser diagnostics that can probe the system without special packaging required for drop tower or flight tests. In addition, the electric field generated ionic winds allow varying gravitational convection equivalents even if the test occurs in reduced gravity environments.

Derived from text

Buoyancy; Combustion; Convection; Electric Fields; Flames

19990054085 NASA Glenn Research Center, Cleveland, OH USA

Flame Spread and Extinction in Partial-Gravity Environments

Sacksteder, Kurt, NASA Glenn Research Center, USA; Ferkul, P. V., National Center for Microgravity Research on Fluids and Combustion, USA; T'ien, J. S., Case Western Reserve Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 523-526; In English; See also 19990053965; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

Considerable progress has been made in understanding the mechanisms of spreading flames under certain conditions, nearly all under the influence of normal Earth gravity. Recently, several investigators have studied some aspects of flame spread in purely forced flows in microgravity. However, very few have considered (especially experimentally) purely-buoyant flow influences, using gravity as a variable. In addition to the scientific interest in understanding how variable gravity affects flame spread in purely-buoyant flow, prospective human exploration of the Moon and Mars provides an incentive to obtain practical knowledge for use in fire-safety related engineering and mission operations in those partial-gravity environments. The purpose of this research effort is to conduct a focused experimental effort to observe the behavior of flames spreading both upward (concurrent flow) and downward (opposed flow) over thin fuels in partial-gravity environments, and to extend an existing numerical model of flame spread to predict flammability and flame spread behavior in these two regimes. A significant aspect of the experimental effort is to use a special device to improve the simulated partial-gravity environment achievable aboard reduced-gravity aircraft facilities.

Derived from text

Flame Propagation; Gravitational Effects; Extinction; Flammability; Microgravity; Fuel Combustion

31
ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

19990053818 Lawrence Livermore National Lab., Livermore, CA USA

Development and implementation of seismic design and evaluation criteria for NIF

Sommer, S. C.; MacCalden, P. B.; Mar. 17, 1998; 11p; In English; 1998 ASME/JSME joint pressure vessel and piping (PVP) conference

Report No.(s): DE98-056038; UCRL-JC-130113; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The National Ignition Facility (NIF) is being built at the Lawrence Livermore National Laboratory (LLNL) as an international research center for inertial confinement fusion (ICF). This paper provides an overview of NIF, reviews NIF seismic criteria, and briefly discusses seismic analyses of NIF optical support structures that have been performed by LLNL and the Ralph M. Parsons Company, the Architect and Engineer (A and E) for NIF.

NTIS

Inertial Confinement Fusion; Research Facilities; Seismology

19990053852 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

33rd Aerospace Mechanisms Symposium

Boesiger, Edward A., Compiler, Lockheed Martin Missile and Space, USA; Litty, Edward C., Compiler, Jet Propulsion Lab., California Inst. of Tech., USA; Sevilla, Donald R., Compiler, Jet Propulsion Lab., California Inst. of Tech., USA; 33rd Aerospace Mechanisms Symposium; May 1999; 462p; In English, 19-21 May 1999, Pasadena, CA, USA; Sponsored by Lockheed Martin

Missile and Space, USA; See also 19990053853 through 19990053888; Conference cosponsored by the Aerospace Mechanics Symposium
Contract(s)/Grant(s): NAS7-1407
Report No.(s): NASA/CP-1998-209259; NAS 1.55:209259; No Copyright; Avail: CASI; A20, Hardcopy; A04, Microfiche

The proceedings of the 33rd Aerospace Mechanisms Symposium are reported. JPL hosted the conference, which was held at the Pasadena Conference and Exhibition Center, Pasadena, California, on May 19-21, 1999. Lockheed Martin Missiles and Space cosponsored the symposium. Technology areas covered include bearings and tribology; pointing, solar array and deployment mechanisms; orbiter/space station; and other mechanisms for spacecraft.
Author
Conferences; Mechanical Devices; Deployment; Spacecraft Components; Mechanization; Folding Structures; Expandable Structures

19990054582 Army Test and Evaluation Command, Aberdeen Proving Ground, MD USA
Technical Feasibility Test of the High Mobility Trailer (HMT) ***Final Report, 26 Jan. - 22 Apr. 1999***
Parker, Raymond G., Jr, Army Test and Evaluation Command, USA; Apr. 22, 1999; In English
Report No.(s): AD-A363455; No Copyright; Avail: Issuing Activity, Microfiche

Two High Mobility Trailers (HMTs), serial numbers 05809 and 05811 were provided for testing. Prior to the start of testing, steel drawbar frame improvement kits were applied to both test trailers. The steel drawbar kit was developed to address failures of the standard aluminum drawbar and will be applied to all produced HMTs as a retrofit kit. Both test trailers were equipped with the standard model Six surge brake assembly. DETAILS OF TEST Testing was conducted to ascertain a speed at which an HMT loaded to 4200 pounds gross vehicle weight (GVW) could traverse Perryman level cross country 2 and 3 test courses (PTA-2 and PTA-3) without damaging the trailer or its prime mover. The trailers were towed for 2000 miles on PTA-2 and for 1500 miles on PTA-3 at speeds not exceeding 10 miles per hour (mph). At 500 mile intervals, the rear bumper assembly of the High Mobility Multi-purpose Wheeled Vehicle (HMMwV) prime movers and the drawbar/surge brake assemblies of the test trailers were inspected. Inspection of the surge brake involved disassembly of the brake actuator to remove the inner slide and visually inspect for cracks or abnormal wear.
DTIC
Test Equipment; Test Vehicles; Trailers; Fractures (Materials)

32
COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications. For related information see also 04 Aircraft Communications and Navigation and 17 Space Communications, Spacecraft Communications, Command and Tracking. For search and rescue see 03 Air Transportation and Safety, and 16 Space Transportation.

19990053590 IBM Slovenia, Ljubljana, Slovenia
Multimedia Communications Requirements ***Zahteve za Vecpredstavne Komunikacije***
Verlic, Robert, IBM Slovenia, Slovenia; Ozimek, Igor, Stefan (J.) Inst., Slovenia; Electrotechnical Review; 1998; Volume 65, Nos. 2-3, pp. 133-137; In Slovene; See also 19990053584; No Copyright; Avail: Issuing Activity (Elektrotehniski Vestnik, Fakulteta za Elektrotrhniko, Trzaska 25, 1001Ljubljana, Slovenia), Hardcopy, Microfiche

Multimedia data consist of many different types of information (video, audio, images, text) integrated together, according to their own processing and transmission requirements. Any multimedia system and network provides a certain level of performance, when data are compressed, coded and transmitted. These characteristics are denoted as QoS (Quality of Service). They include many parameters such as: delay, delay variation, BER (Bit Error Rate), bandwidth, etc. One can examine the relevant parameters and establish required values to support multimedia communications at a certain level of quality.
Author
Bit Error Rate; Multimedia; Communication

19990053693 Aerospace Corp., Technology Operations, El Segundo, CA USA
Semiclassical Random Electrodynamics: Spontaneous Emission and the Lamb Shift
Camparo, J. C.; Apr. 15, 1999; 13p; In English
Contract(s)/Grant(s): F04701-93-C-0094
Report No.(s): AD-A363360; TR-98(8555)-2; SMC-TR-99-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

It is often remarked that an explanation of spontaneous emission and the Lamb shift requires quantization of the electromagnetic field. Here, these two quantities are derived in a semiclassical formalism by use of second-order perturbation theory. The purpose of this report is not to argue the validity of QED but rather to develop a semiclassical approximation to QED that may nonetheless have certain computational advantages over QED. to this end, the vacuum of QED is simulated with a classical zero-point field (ZPF), and as a consequence, the resulting theory is entitled semiclassical random electrodynamics (SRED). In the theory, the atom is coupled to the ZPF and to its own radiation-reaction field through an electric dipole interaction. These two interactions add to produce exponential decay of excited states while they cancel each other to prevent spontaneous excitation of the ground state; the Lamb shift appears in the theory as an ac Stark shift induced by the ZPF. The spontaneous decay rate of an excited-state derived in SRED is equal to the Einstein A coefficient for that state, and the Lamb shift agrees with that of nonrelativistic QED. Moreover, SRED is shown to be useful for the numerical simulation of spontaneous decay.
DTIC
Quantum Electrodynamics; Perturbation Theory; Spontaneous Emission; Electrodynamics; Lamb Waves

19990053705 Schafer Corp., Albuquerque, NM USA
GLINT
Feb. 1999; 45p; In English
Contract(s)/Grant(s): N00014-97-D-2014
Report No.(s): AD-A361747; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

GLINT is the acronym for Geo Light Imaging National Testbed. Schafer has supported this AFRL program in three basic areas for the Surveillance Technologies Branch (DEBS). The first area is the collation of information to develop a target database of geosynchronous (GEO) satellites. Each possible target needs to be investigated in order to obtain permission from the owner/operator to illuminate it. This information, when obtained, would be part of the database as well. The second area addresses a major operational concern for GLINT. A necessary prerequisite to illumination of GEO satellites by GLINT is the ability to ascertain that the object acquired is the intended target. The GEO satellites are unresolved to any single pupil associated with aperture sizes we are now capable of building. GLINT will be able to image them using an active Fourier telescopy scheme. However, due to international agreements and the safety of instrumentation on-board these satellites, a non-imaging method to first identify that the acquired object is the target in question. This second area is the Signatures Program. Its goal is to pursue non-imaging techniques to obtain satellite information and reduce uncertain identification (ID) in preparation for active illumination by GLINT. The final area of support was the study on a relay mirror experiment that could be performed with GLINT.
DTIC
Target Recognition; Satellite Imagery; Imaging Techniques

19990053706 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
A Climatology-Based Model for Long-Term Prediction of Radar Beam Refraction
Pittman, Todd S.; Mar. 1999; 184p; In English
Report No.(s): AD-A361749; AFIT/GE/ENG/99M-23; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The National Air Intelligence Center, WPAFB, OH, needs more accurate predictions of radar beam refraction. A new mode was developed for this thesis replacing the standard atmosphere approach with raytracing and climatology. Usually a microwave radio beam bends towards the earth with a radius of curvature greater than the earth's surface. However, seasonal and climatic variations influence the bending, and at times create temperature or moisture inversions that redirect the energy along the earth's surface leaving radio holes where there is no coverage. This model uses iterative raytracing to determine the most direct path from radar to target through the climatologically predicted refractive atmosphere. The height error is calculated by comparing the geographic path to the refracted path. Only vertical refractivity variation (including the effects of ducting) is taken into account. The model computed height errors at 17 locations worldwide for a target at 10,000 feet and 60 nautical miles that varied from 100 feet to 2260 feet compared to 804 feet predicted by standard atmosphere. The model traces to all targets when no ducting is modeled, to all targets outside the duct with surface ducting, and to some targets outside the duct with elevated ducting due to ducting ambiguities.
DTIC
Radar; Ray Tracing; Atmospheric Refraction; Aerial Reconnaissance; Radar Beams; Mathematical Models; Climatology

19990053735 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Terrain Backscattering Coefficient Generator
Mediavilla, Ricardo; Mar. 1999; 88p; In English
Report No.(s): AD-A362716; AFIT/GE/ENG-99M-18; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Using already available data, a backscattering coefficient generator (BCG) for several types of terrain and measurement conditions is developed. The types of terrain are: (1) soils and rocks, (2) trees, (3) grasses, (4) shrubs, (5) short vegetation, (6) roads, (7) urban areas, (8) dry snow, and (9) wet snow. These data sets typically cover incidence angles ranging between 0 and 80 degrees where 0 is normal to the terrain. Measurement conditions are defined by: (1) incidence angle, (2) wave polarizations configuration (HH, HV, or VV), and (3) radar band (L, C, S, X, Ku, Ka, or W). The BCG output matches very closely the first and second moments of the published data. A modified chi-square goodness of fit test at a 0.05 significance level is introduced to automatically validate the generated output with measured data histograms. The BCG reproduces 100% of measured mean backscattering coefficient (BC) and standard deviation values. The modified validation test failed to reject the BCG output as representative of the measured data for 72% of simulated distributions having a database-source-point number (N) greater than 100. Noted discrepancies can be attributed to sparse BC data histograms and BCG limitations at incidence angles less than 20 degrees for certain terrain types.
DTIC
Backscattering; Statistical Tests; Standard Deviation

19990053742 Naval Postgraduate School, Monterey, CA USA
THAAD Radar: Examination of a Cost Saving Initiative
Lewis, John W.; Mar. 1999; 96p; In English
Report No.(s): AD-A362644; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This thesis analyzes two acquisition reform initiatives that made Theater High Altitude Area Defense (THAAD) Radar Product Office's Best of Breed Transmit/Receive Module study a success and examines the risk involved in the pursuit of this study. The initiatives are Cost As an Independent Variable (CAIV) and commercial items in the form of dual-use technology. Analysis of the radar subsystem of THAAD reveals a major cost driver to be the transmit/receive (T/R) module in the antenna equipment. The Best of Breed study examined techniques in the design, engineering, and manufacturing of these modules and its components in order to aggressively reduce the unit cost. Using tenets of CAIV, THAAD Radar Product Office was able to define a study such that the contractor would recommend a low risk solution to achieve cost reductions of almost 50% for the module. Additionally, the Product Office was able to accomplish this without sacrificing performance or schedule. The commercial application of the T/R module was an important factor in motivating the contractor to seek aggressive cost reductions. Lessons from this case may be applicable to other programs seeking to reduce cost.
DTIC
Costs; Signal Reception; Manufacturing; Transmission

19990053796 Defence Science and Technology Organisation, Information Technology Div., Canberra Australia
A Technique for Measuring the Gain of HF Antennas
Ayliffe, J. K., Defence Science and Technology Organisation, Australia; Coleman, C. J., Defence Science and Technology Organisation, Australia; Gooley, K. W., Defence Science and Technology Organisation, Australia; Lane, J., Defence Science and Technology Organisation, Australia; Sweetman, E., Defence Science and Technology Organisation, Australia; Sep. 1998; 30p; In English
Report No.(s): AD-A362876; DSTO-TR-0654; DODA-AR-010-510; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A technique for characterizing large HF (High Frequency) antennas is considered. The approach achieves this by comparing radar returns from a target illuminated by the unknown antenna with returns from the same target illuminated by a well characterized antenna. Results from a trial confirm that the method is effective.
DTIC
Radiation Measurement; High Frequencies; Radar Antennas

19990053798 Texas Univ., Dept. of Electrical and Computer Engineering, Austin, TX USA
Radar Image Enhancement, Feature Extraction and Motion Compensation Using Joint Time-Frequency Techniques ***Annual Report, 15 Apr. 1998 - 14 Apr. 1999***
Ling, Hao, Texas Univ., USA; Wang, Y., Texas Univ., USA; Li, J., Texas Univ., USA; Deng, H., Texas Univ., USA; May 01, 1999; 79p; In English
Contract(s)/Grant(s): N00014-98-1-0615
Report No.(s): AD-A363380; UT-ECE-1; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This Report summarizes the scientific progress on the research grant "Radar Image Enhancement, Feature Extraction, and Motion Compensation Using Joint Time-Frequency Techniques" during the period April 15, 1998 - April 14, 1999. Progress on

removal of interferences due to rotating parts, image formation of measured data, and clutter rejection based on wavelet packets is presented.
DTIC
Synthetic Aperture Radar; Imaging Radar; Radar Equipment; Radar Imagery; Remote Sensors

19990053822 Communications Research Lab., Tokyo, Japan
Review of the Communications Research Laboratory, Volume 43
Dec. 1997; ISSN 0914-9279; 134p; In English; In Japanese; See also 19990053823 through 19990053833; Original contains color illustrations; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Contents include the following: Generator of coherent light and its applications. Research and advanced technologies for controlling lasers. Superconducting device technology and high frequency application. Emission of electromagnetic wave from semiconductor and superconductor. Molecular mechanism of force and movement generated by motor proteins. Fluorescence imaging of cellular structures. Research on nanotechnology and molecular electronics. Toward and computer that can talk with humans - research on the mechanism of the dialogue. Research and development on intelligent information processing based on sensory mechanism of biological organism. and Research on the engineering realization of advanced intelligent functions.
CASI
Imaging Techniques; Lasers; Semiconductors (Materials); Superconductors (Materials); Technology Utilization

19990053826 Communications Research Lab., Tokyo, Japan
Emission of Electromagnetic Wave From Semiconductor and Superconductor
Sakai, Kiyomi, Communications Research Lab., Japan; Tani, Masahiko, Communications Research Lab., Japan; Tonouchi, Masayoshi, Communications Research Lab., Japan; Matsuura, Shuji, Communications Research Lab., Japan; Hukasawa, Ryoichi, Communications Research Lab., Japan; Abe, Hajime, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 637-650; In Japanese; See also 19990053822; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

To exploit the terahertz gap between the frequencies of radio waves and light waves (i.e., between 100 GHz and 10 THz), we have developed novel technologies taking advantage of the latest advances in lasers, semiconductors and superconductors. We describe three schemes for generating terahertz radiation: a) Terahertz electromagnetic pulses are generated from photoconductive antennas fabricated on low-temperature-grown GaAs (LT-GaAs) films by exciting the antenna with femtosecond laser pulses. The terahertz pulses originate from the rapid changes in the photocurrent. b) CW tunable terahertz electromagnetic waves are also generated from the same photoconductive antennas by exciting them with two diode laser beams oscillating at frequencies that differ a little. c) Terahertz electromagnetic pulses are generated from superconducting YBCO thin films on the MgO substrate by irradiating the films with femtosecond laser pulses. The terahertz emissions are observed from YBCO films with a bias current or with a magnetic field. Spectroscopic measurements demonstrate the usefulness of such sources.
Author
Emission; Electromagnetic Radiation; Semiconductors (Materials); Superconductors (Materials); Radio Waves; Continuous Radiation; Gallium Arsenides; Electromagnetic Pulses

19990053893 National Telecommunications and Information Administration, Inst. for Telecommunication Sciences, Boulder, CO USA
Man-Made Noise in the 136 to 148-MHz VHF Meteorological Satellite Band
Achatz, R. J., National Telecommunications and Information Administration, USA; Lo, Y., National Telecommunications and Information Administration, USA; Papazian, P. B., National Telecommunications and Information Administration, USA; Dalke, R. A., National Telecommunications and Information Administration, USA; Hufford, G. A., National Telecommunications and Information Administration, USA; Sep. 1998; 86p; In English
Report No.(s): PB99-127052; NTIA-98-355; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Satellite radio system performance in the 136 to 138-MHz VHF meteorological satellite band is compromised by man-made noise external to the receiver. Methods used for predicting man-made noise power in this band are based on measurements conducted in the 1970's. These methods may be inaccurate due to technological advances such as the personal computer. This report describes noise power measurements the Institute for Telecommunication Sciences performed in the 136 to 138-MHz VHF meteorological satellite band. Statistics of average noise power were compared to those of measurements conducted in the 1970's. The noise power measurements were also used to model instantaneous noise power for simulation of radio links.
NTIS
Meteorological Satellites; Noise (Sound); Very High Frequencies; Electromagnetic Interference; Satellite Communication

19990054153 Syracuse Univ., Dept. of Electrical and Computer Engineering, NY USA

A Knowledge-Based Interference Rejection Scheme for Direct-Sequence Spread-Spectrum Systems ***Final Report, Jun. 1995 - Mar. 1998***

Varshney, P. K., Syracuse Univ., USA; Weiner, D. D., Syracuse Univ., USA; Nawab, S. H., Syracuse Univ., USA; Demirkiran, I., Syracuse Univ., USA; Samarasooriya, V. N., Syracuse Univ., USA; Mar. 1999; 102p; In English; Prepared in cooperation with Boston Univ., Dept. of Electrical and Computer Engineering, Boston, MA.

Contract(s)/Grant(s): F30602-95-C-0204; AF Proj. 4519

Report No.(s): AD-A362918; AFRL-IF-RS-TR-1999-53; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Spread-spectrum signals are used widely in military and commercial communication systems due to their interference rejection capability and their lower probability of interception. In military applications the effects of intentional interference (jamming) are mitigated by the processing gain of the spread-spectrum system. In many spread-spectrum systems, processing gain alone is not sufficient to achieve satisfactory system performance and additional interference rejection techniques need to be employed. The interference suppression circuit is placed prior to the spectrum despreader with the goal of reducing the jammer/interferer energy to an adequately low level that can be handled by the system processing gain. We have presented a novel knowledge-based interference cancellation scheme for direct sequence spread-spectrum systems. This innovative approach utilizes: (1) IPUS, an expert system for the Integrated processing and Understanding of signals, to monitor the communication signal environment in order to determine the parameters of interfering signals within a pre-specified accuracy, and (2) Expert system rules to select from a library of preselected techniques, suitable interference rejection schemes based upon the knowledge obtained from monitoring the signal environment. The effectiveness of this novel interference rejection capability is demonstrated by considering a number of interference scenarios and using the software package SPW(Copyright), a time-domain Signal Processing Worksystem.

DTIC

Signal Processing; Spread Spectrum Transmission; Signal Transmission; Interference Immunity; Frequency Hopping; Jamming

19990054157 Department of the Navy, Washington, DC USA

Secure Communication System

Andrews, Daniel E., Jr., Inventor; Klund, William E., Inventor; Isaak, Robert D., Inventor; Sep. 08, 1998; 4p; In English; Supersedes US-Patent-Appl-SN-352687

Patent Info.: Filed 17 Mar. 64,; US-Patent-Appl-SN-352,687; US-Patent-5,805,635

Report No.(s): AD-D019335; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a secure communication system comprising: a first cyclical pseudo-random noise generator comprising determinable variable starting point means and an output; transmitting means for transmitting said pseudo-random noise generator output; receiving means for receiving said transmitting means transmissions, said receiving means having an output; recycling storage means for storing said receiving means output; a second cyclical pseudo-random noise generator identical to said first pseudo-random noise generator having an output and a reset input, said receiving means output connected to said reset input; a correlator having a first input connected to said storage means and a second input connected to said second pseudo-random noise generator output and an output from said correlator; and timing means connected to said receiving means output and said correlator output for measuring time elapsed between any output of said receiver and said correlator.

DTIC

Correlators; Receivers; Cycles

19990054164 Department of the Navy, Washington, DC USA

Wideband High Isolation Circulator Network

Ho, Thinh Q., Inventor; Hart, Stephen M., Inventor; Kosinovsky, Gregory A., Inventor; Henry, Willard I., Inventor; Sep. 29, 1998; 5p; In English

Patent Info.: Filed 8 Mar. 96,; US-Patent-Appl-SN-614,782; US-Patent-5,815,803

Report No.(s): AD-D019296; No Copyright; Avail: US Patent and Trademark Office, Microfiche

An isolation circulator network includes three circulators and a 180 degree hybrid coupler for isolating an RF transmitter from a nearby RF receiver. The isolation circulator network comprises: a first circulator for transforming a first RF signal, RF1, into a second RF signal, RF2 and a third RF signal, RF3; a second circulator for throughputting the third RF signal; a third circulator for transforming the second RF signal into a fourth RF signal, RF4, and a fifth RF signal, RF5, and for throughputting a sixth RF signal, RF6; and a 180-degree hybrid coupler which provides a seventh RF signal, RF7 in response to receiving the third, fifth, and sixth RF signals, where RF7=(RF5-RF3+RF6).

DTIC

Broadband; Radio Frequencies; Couplers

19990054217 Research and Technology Organization, Information Systems Technology Panel, Neuilly-sur-Seine, France
Frequency Assignment, Sharing and Conservation in Systems (Aerospace) ***L'Attribution, le Partage et la Conservation des Frequences pour les Systemes Aeronautiques et Spatiales***
Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999; 224p; In English; Information Systems Technology, 5-7 Oct. 1998, Aalborg, Denmark; See also 19990054218 through 19990054236; Original contains color illustrations Report No.(s): RTO-MP-13; AC/323(IST)TP/1; ISBN 92-837-0003-1; Copyright Waived; Avail: CASI; A10, Hardcopy; A03, Microfiche

This volume contains the Technical Evaluation Report, the Keynote Address and the 18 unclassified papers, presented at the Information Systems Technology (IST) Panel Symposium held in Aalborg, Denmark from 5th to 7th October 1998, The papers presented covered the following headings: Spectrum Management and Use; and Emerging Technology and Criteria.
Author
Conferences; Information Systems; Frequency Assignment; Systems Management

19990054218 Defence Evaluation Research Agency, Malvern, UK
Application of New Techniques to Military Frequency Assignment
Bradbeer, Ray, Defence Evaluation Research Agency, UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 1-1 - 1-6; In English; See also 19990054217; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

With increasing use of the RF spectrum, rapid and effective frequency assignment tools are an essential element in the maintenance of effective communications. An abstraction of the VHF Combat Radio Frequency Assignment problem is outlined and discussed in this paper. A key feature of this problem is the wide difference in the magnitude of the frequency separation constraints which arise as a result of radios being located in the same vehicle or site (cosited), and those which apply between nets which do not have cosited members. This feature is used to gain insight into the problem. It is inferred that, within the vast total solution space, it must be assumed that there are a great many optima or near optimal solutions. A proposed method using graph colouring together with a combinatorial algorithm is outlined. This uses the characteristic large differences between the constraints to focus the search on profitable areas of the solution space.
Author
Algorithms; Combinatorial Analysis; Frequency Assignment; Applications Programs (Computers)

19990054219 IIT Research Inst., Joint Spectrum Center, Annapolis, MD USA
Spectrum Certification: The First Step
Green, Stanley R., IIT Research Inst., USA; Scammon, Craig A., National Telecommunications and Information Administration, USA; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 2-1 - 2-10; In English; See also 19990054217; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Assigning frequencies for electronic systems on the ever diminishing electromagnetic spectrum is a difficult process, compounded by the different modeling approaches that employ complex frequency assignment algorithms. These algorithms are based on the available equipment parameters and environmental data. The underlying assumption is that the data being used is the best and the most accurate data available. This assumption is rarely if ever correct. But with today's highly sophisticated technology in electronic equipment, having the most accurate data available for use in spectrum management systems such as the Joint Spectrum Management System for Windows (JSMS(sub W)) frequency assignment model is critical. Collecting accurate data begins with the request for spectrum allocation support, via the application for electronic equipment certification. This data collection continues through equipment design, procurement, and operational deployment of the electronic system. Traditionally, this collection of data began by entering the pertinent system data on a paper form. Today, a template for this form has been created, and the process for entering data has been automated by using the Spectrum Certification System (SCS). The National Telecommunications and Information Administration (NTIA) has been working on a new approach to capture the required data, using a Smart Interface Diagram (SID) technology. A computer software program called the Equipment Location - SID (EL_SID) that will automate the SID is under development. This program provides a graphical, icon-based user interface supported by sophisticated logic that captures inter- and intra system relationships and prompts the applicant to enter minimal but pertinent system parameters. The EL_SID interface will simplify the collection of data, enabling the applicant to enter the most comprehensive, and the most accurate, information available for particular operational characteristics of the electronic equipment. The EL_SID interface will also enhance earlier efforts at defining system characteristics by identifying the actual relationship between equipment parameters for the links in a network, and thus will provide the best available operating characteristics. This paper will

describe the spectrum allocation process, provide a historical background of data entry, and look to the future for spectrum allocation and assignment.
Author
Spectra; Frequency Assignment; Electromagnetic Spectra; Data Acquisition; Computer Programs; Certification; Systems Management

19990054220 IIT Research Inst., Joint Spectrum Center, Annapolis, MD USA
Spectrum Management Using JSMS(sub W)
Hensler, Thomas C., IIT Research Inst., USA; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 3-1 - 3-12; In English; See also 19990054217; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The Joint Spectrum Management System for Windows (JSMS(sub W)) is a set of frequency management tools that runs on a personal computer. JSMS(sub W) provides the spectrum manager with the capability to create assignment proposals, edit them and perform validation checking of the proposal. The user then uses JSMS(sub W) to format the proposal for transmission to the US National Authority for approval. Other tools included are an interference reporting capability and an allotment plan generator which enables users to define the frequency resources for the frequency nomination capability. This paper focuses on the eight discrete steps performed during the JSMS(sub W) frequency nomination process. These steps are to: specify the parameters, select the environment records, create analysis records, cull environmental records not likely to interfere or to be subject to interference from the proposal, compute received interference power and system noise power levels, determine interference-free frequencies, and, then last, rank the proposed frequencies.
Author
Systems Management; Windows (Computer Programs); Spectra; Frequency Assignment

19990054221 Elmer, Rome, Italy
HF Frequencies: Sharing Among NATO Countries
Proia, M., Elmer, Italy; Maviglia, G., Elmer, Italy; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 4-1 - 4-10; In English; See also 19990054217; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

In this paper, an efficient use of HF frequencies (2MHz to 30MHz) is investigated to establish radiocommunication between moving platforms operating in a given area and ground-based fixed stations suitably located to provide effective coverage of the area. In the first part of this paper, the use of the HF spectrum (2MHz to 30MHz) as a primary communication resource is justified, taking into consideration that the constraints associated with ionospheric propagation and spectrum congestion require efficient use of the available frequencies. These constraints may produce degradation in the skyway links. Considering the problem of communication between mobile units and ground-fixed stations in a NATO environment, the following part of the paper contains a description of the basic concepts followed by the ELMER engineering activity in the development of an HF radio communication system intended to allow any mobile unit to establish a link with at least one ground station within a predefined pool. This is achieved through mapping of the communication area by ground stations suitably located, combined with an efficient frequency management. An application is described in which the system concept is validated of the Mediterranean area. It should be understood, however, that the results of the investigation can be validated for any other area, with some modifications, if any.
Author
High Frequencies; Telecommunication; Radio Communication; Product Development; Communication Equipment

19990054222 ATDI Ltd., Crawley, UK
Optimisation of the Radio Spectrum: The Role of Computer Radio Prediction Packages
Graham, Adrian, ATDI Ltd., UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 5-1 - 5-10; In English; See also 19990054217; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

It is recognized that a useful measurement factor in the assessment of spectrum management effectiveness is the number of users per square kilometre per MHz. Given that there is a requirement to maximize this factor, this paper examines computerized methods currently available to assist in the optimisation of spectrum usage. A methodology to extend this technology towards a more critically engineered solution is then examined.
Author
Optimization; Radio Spectra; Technology Assessment

19990054223 London Univ., Centre for Discrete and Applied Mathematics, UK

Real-Valued Frequency Assignment

FonDerFlaass, D. G., London Univ., UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 6-1 - 6-4; In English; See also 19990054217; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

We consider the binary constraints formulation of the frequency assignment problem in its most general form: for an arbitrary metric space, with frequencies taking arbitrary real values, and with possibly infinitely many constraints. We obtain some necessary and sufficient conditions for the problem to have a solution with a finite span. When the metric space is the set of integers, we give an exact criterion. Also we demonstrate a connection of this problem in one-dimensional case with one combinatorial question about finite permutations; and pose some unsolved problems.

Author

Frequency Assignment; Combinatorial Analysis; Communication Networks

19990054224 GEC-Marconi Research Centre, Great Baddow, UK

HF Frequency Management: Prediction and Assignment Tools for Large Networks

Wheadon, N. S., GEC-Marconi Research Centre, UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 7-1 - 7-10; In English; See also 19990054217; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

With the advent of automatic and adaptive radio communications systems there has been a resurgence of activity in propagation at HF. The development of Automatic Link Establishment (ALE) and Automatic Link Maintenance (ALM) systems suggested the demise for HF prediction programs. These new systems would not need experienced operators and the systems would perform all the necessary frequency management tasks themselves. ALE and ALM have gone some way in optimizing the operation of systems on air; however in order to optimize the use of the HF spectrum, a planning exercise is still required which will provide a reasonable first selection of frequencies. For example, allocating the high end of the band for short range near-vertical incidence skywave operations in winter at midnight would not necessarily be a sensible choice. This ”first cut” planning exercise could be performed using radios which contain simple software planning tools but coordination between separated users wishing to communicate becomes an issue. Alternatively the planning exercise can be performed using more sophisticated assignment tools located at a strategic centre or at a tactical command post. This paper describes two tools which can be used to perform tasks from the simple estimation of usable frequencies to more complex frequency allocation for large networks.

Author

Telecommunication; Frequency Assignment; Radio Communication; Communication Networks

19990054225 Thomson-CSF Airsys, Bagneux, France

Low Frequency Radars: Compatibility With Other Electromagnetic Means *Radars Basse Frequence: Compatibilite avec les Autres Moyens Electromagnetiques*

Zolesio, J. L., Thomson-CSF Airsys, France; Olivier, B., Thomson-CSF Airsys, France; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 8-1 - 8-4; In French; See also 19990054217; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

The growth of military threats has led to the development of systems for detecting and evaluating threats. The capacities of these systems must continually be expanded even as economic constraints become ever more stringent. For surface systems, the current threat displays the following characteristics: (1) reduced SER (missiles, low-detectability and even stealth planes, etc.); (2) extended flight envelopes (from very low altitude for cruise missiles up to the zenith for ARM missiles); (3) increased flight dynamics which allow for use of natural field masks (helicopters an cruise missiles) and/or very high speeds; and (4) increased electronic countermeasure abilities with traditional interference and with signature masking by passive means (absorbers, adapted shapes) or active means.

Author

Low Altitude; Radar; Compatibility; Display Devices; Low Frequencies; Aircraft Detection

19990054226 Wales Univ. Inst. of Science and Technology, Dept. of Computer Science, Cardiff, UK

Optimizing Radio Network Design

Chapman, Simon J., Wales Univ. Inst. of Science and Technology, UK; Hurley, Steve, Wales Univ. Inst. of Science and Technology, UK; Kapp-Rawnsley, Rupert, Wales Univ. Inst. of Science and Technology, UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 9-1 - 9-12; In English; See also 19990054217; Original contains color illustraions

Contract(s)/Grant(s): ESPRIT Proj. 23243; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Designing radio networks that utilize their allocated frequencies effectively and efficiently is a difficult problem. If a radio network is poorly designed then spectrum will be wasted and/or the quality of service will be degraded even if a good frequency assignment algorithm is used. to produce a well designed network the designer needs to take into account several competing factors. For example, cost may be reduced by having a few omni-directional antennas operating at full power, this may produce good area coverage and have a small amount of overlap between areas (and hence low interference). However, such a network may not be able to satisfy the traffic demands within the area assigned to each antenna i.e. its cell. to try and overcome this problem more antennas are required (perhaps using directional antennas at the same site or additional antennas at different sites). However this increases the cost, the potential for interference, and increases the difficulty of finding a good frequency assignment. For example, if the network design is used to generate channel separation constraints between pairs of transceivers then the required separations could have higher values on a poorly designed network relative to a well designed network. Consequently, frequency assignment algorithms e.g.,will find assignments which either use a larger range of frequencies than may be necessary (for minimum span assignment) or have a higher number of constraint violations in fixed spectrum problems. The radio network optimisation problem involves designing a radio network using an optimisation algorithm that takes into account competing factors. For example, the final network can be optimized for cost, interference, handover and traffic demands. Other constraints can be included as necessary.

Author

Optimization; Algorithms; Radio Communication; Frequency Assignment; Communication Networks

19990054227 North Atlantic Treaty Organization, Frequency Management Branch, Brussels, Belgium

The Impact of Protection Criteria and Assignment Order on Military Air Ground Air Frequencies

Kho, K. S., North Atlantic Treaty Organization, Belgium; Elliot, M., North Atlantic Treaty Organization, Belgium; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 10-1 - 10-10; In English; See also 19990054217; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Tactical air communications use the UHF 225-400 MHz military band in NATO Europe. Overall management of the military use of the band is performed by the NATO Frequency Management Sub-Committee (FMSC). The band is divided into allotments for each type of system e.g. Radio Relay (R/R), [Instrument Landing System (ILS),] UHF Satellite and Air-Ground-Air (A/G/A), based on an Allotment Plan agreed by the FMSC. The management of the A/G/A assignments is then performed centrally by the Frequency Management Branch (FMB) of the NATO HQ C3 Staff at NATO HQ, using a software tool called NATO UHF Frequency Assignment System (NUFAS 2). This paper first describes the assignment system of NUFAS 2 and then focuses on the results of an investigation into the impact of assignment order on the results of a bulk assignment process. Paragraphs 2 to 7 are background information for your convenience.

Author

Frequency Assignment; Radio Communication; Allocations

19990054228 Royal Holloway, Dept. of Computer Science, Egham, UK

Are There Effective Binary Frequency Separation Constraints for Frequency Assignment Coverage Problems?

Bater, Joe, Royal Holloway, UK; Jeavons, Peter, Royal Holloway, UK; Cohen, David, Royal Holloway, UK; Dunkin, Nick, Royal Holloway, UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 11-1 - 11-8; In English; See also 19990054217; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Frequency assignment in cellular radio networks is often modelled using binary constraints between pairs of transmitters. These constraints restrict possible frequency channel assignments in order to reduce the risk of unacceptable interference. Here we question the adequacy of binary constraints of this kind to represent the problem effectively. In this paper we examine the use of binary constraints, based on predicted interference between pairs of cells, Having generated the binary constraints, they are solved using standard heuristic solution techniques, and tested back against the original system model. In many of the instances these solutions fail to provide complete coverage. by considering solutions calculated directly from the system model (i.e. a single global constraint), we obtain solutions to all problem instances which provide perfect predicted coverage. to achieve coverage in the binary model it is necessary to tighten the constraints in these instances by increasing the reference carrier-to interference thresholds at which constraints are enforced. This additional restriction forces the number of channels used in the solution to grow beyond that required of the global constraint solution. We conclude that representing the frequency assignment problem using binary constraints may be inadequate to capture the essential features of the problem, and that it may be necessary to include higher-order information in any effective model. Another conclusion concerns the lower bounds on the number of channels required that are sometimes calculated from a binary constraint model, using maximal cliques in the constraint graph, or other techniques.

If the binary constraint model is not an adequate representation of the problem, then any such lower bound may be unreliable as an estimate of the spectral resources required for a cellular system.
Author
Frequency Assignment; Constraints; Carrier to Noise Ratios

19990054229 Universidad Carlos 3 de Madrid, Dept. Tecnologias de las Communicaciones, Madrid, Spain
Emerging Techniques for Dynamic Frequency Assignment: Merging Genetic Algorithms and Neural Networks
Bousono-Calzon, C., Universidad Carlos 3 de Madrid, Spain; Figueiras-Vidal, A. R., Universidad Carlos 3 de Madrid, Spain; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 12-1 - 12-6; In English; See also 19990054217; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Genetic algorithms and neural networks have previously been applied to the hard problem of assigning channels in mobile communication systems. The interest in these algorithms is due to their generality and the possibility of fast hardware implementations that adapt to dynamical environments. Nevertheless, these algorithms perform differently: neural nets are known to better satisfy allocation constraints while genetic algorithms allow for global optimisation. We propose here to merge the best features of both algorithms in a quite natural manner. Simulations show that this merging has good performance, and suggest a new interesting direction for research.
Author
Genetic Algorithms; Neural Nets; Mobile Communication Systems; Systems Simulation; Dynamical Systems; Frequency Assignment

19990054230 Diehl G.m.b.H. und Co., Roethenbach, Germany
Electromagnetic Coupling Paths to Electronic Systems Connected with Electronic Setups and Destruction Mechanisms
Bohl, Juergen, Diehl G.m.b.H. und Co., Germany; Ehlen, Tilo, Diehl G.m.b.H. und Co., Germany; Sonnemann, Frank, Diehl G.m.b.H. und Co., Germany; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 13-1 - 13-6; In English; See also 19990054217; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Within an investigation containing both measurements and intensive simulations an effective model creation for the examination of the coupling behaviour of HF interference and the coupling paths into electronic circuits is intended. Based on the predictions deriving from these results adequate hardening measures regarding functionality disturbances due to HF interference can be considered already in the development and design process. Electromagnetic field simulation programs are necessary for the analysis of the coupling effects into materials, the creation of signal amplifying body resonances and the coupling into power and signal wires. Network analysis programs are responsible for the detection of the HF-LF conversion at the electrical non-linearities and the computation of the radiation of the LF disturbance within the electronic circuit. The various electromagnetic interferences during the coupling process and the respective simulation programs are compared. A meaningful network analysis requires a coupling of these specific simulation tools.
Author
Electromagnetic Coupling; Computerized Simulation; Electromagnetic Interference; Circuits

19990054231 British Telecom Research Labs., Intelligent Systems Research Group, Ipswich, UK
Solving the Radio Link Frequency Assignment Problem Using Guided Local Search
Voudouris, Christos, British Telecom Research Labs., UK; Tsang, Edward, Essex Univ., UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 14a-1 - 14a-12; In English; See also 19990054217; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

In this paper, we examine the application of the combinatorial optimisation technique of Guided Local Search to the Radio Link Frequency Assignment Problem (RLFAP). RLFAP stems from real world situations in military telecommunications and it is known to be an NP-hard problem. Guided Local Search is a metaheuristic that sits on top of local search procedures allowing them to escape from local minima. GLS is shown to be superior to other methods proposed in the literature for the problem, making it the best choice for solving RLFAPs.
Author
Combinatorial Analysis; Frequency Assignment; Radio Frequencies; Optimization

19990054232 Essex Univ., Dept. of Computer Science, Colchester, UK

Solving the Radio Link Frequency Assignment Problem with the Guided Genetic Algorithm

Lau, T. L., Essex Univ., UK; Tsang, E. P. K., Essex Univ., UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 14b-1- 14b-28; In English; See also 19990054217; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The Radio Link Requency Assignment Problem is an abstraction of a real life military application that involves the assigning of frequencies to radio links. This problem set consists of eleven instances that are classed as either a Constraint Satisfaction Optimization Problem or a Partial Constraint Satisfaction Problem. Each problem has different optimization and constraint requirements, and can have up to 916 variables, and up to 5548 constraints. The Guided Genetic Algorithm (GGA) is a hybrid of Genetic Algorithm and meta-heuristic search algorithm Guided Local Search. As the search progresses, GGA modifies both the fitness function and fitness template of candidate solutions based on feedback from constraints. In this paper we have shown that GGA has the best optimality-robustness advantage over current published results.

Author

Frequency Assignment; Genetic Algorithms; Radio Frequencies; Optimization; Heuristic Methods

19990054233 Defence Evaluation Research Agency, Radio Science and Propagation Group, Malvern, UK

A Decision Aid to Predict Monthly Signal Coverage Maps Between 30 and 50 GHz in Europe

Shukla, Anil K., Defence Evaluation Research Agency, UK; Akram, Ammad, Defence Evaluation Research Agency, UK; Konefal, Tad, York Univ., UK; Watson, Peter, Bath Univ., UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 15-1 - 15-12; In English; See also 19990054217; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The requirements of both commercial and military communications operators are towards increased data rates at long ranges to support applications such as the Integrated Digital Battlefield, High Definition Video Transmission (HDTV) and personnel communications for both micro and pico cell coverage. These requirements are forcing system designers and technology engineers to consider ever higher frequencies, such as millimetre wave frequencies (e.g., 20-40 GHz), where the spectrum is currently uncongested and where the necessary wide bandwidths may be available. As the number of commercial and military systems operating within this band increases, the pressure to optimize the packing density whilst minimising spectrum usage, interference and costs will also increase. to aid the effective design and deployment of triservice millimetre wave systems, a first generation MIllimetric Decision Aid System (MIDAS Version-1.0a) has been developed. This aid predicts monthly signal attenuations and availabilities between (initially) 30-50 GHz in the European environment. The tool may be used by system designers for hardware development optimisation, and by system planners to match communications tactics (e.g., platform altitude, range) to the battlespace environment to maximise the operational effectiveness of limited and costly communication assets.

Author

Decision Support Systems; Digital Television; Superhigh Frequencies; Wave Generation; Millimeter Waves; High Definition Television; Frequency Assignment

19990054234 Thomson-CSF, Radars and Contre-Mesures, Elancourt, France

Conditions for Insertion of Wide-Band Radars ***Conditions d'Insertion des Radars a Large Bande***

Isnard, Jean, Thomson-CSF, France; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 16-1 - 16-8; In French; See also 19990054217; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The implementation of wide-band signals in radars results of the need to discriminate / classify targets, to resist countermeasures and to obtain precise maps of certain areas. Depending on the applications the signal waveforms and their spatial-temporal conditions of transmission will have to be harmonized among themselves and with those utilized by other applications; indeed it will become increasingly necessary to share at least partly the bandwidths for a better use of the spectral resource. This paper outlines the internal and external conditions for the radio localisation service: the sharing of bandwidths between radars and other equipment in particular for radio communications should be possible provided that mutual constraints are accepted.

Author

Bandwidth; Radar; Broadband; Frequency Assignment; Frequency Control

19990054235 Thomson-CSF, Radars and Contre-Mesures, Elancourt, France

Airborne Metric Frequency Surveillance Radar (UHF-VHF)

Lacomme, P., Thomson-CSF, France; Carrara, B., Thomson-CSF, France; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 17-1 - 17-2; In English; See also 19990054217; Copyright Waived; Avail: CASI; A01, Hardcopy; A03, Microfiche

This paper presents a new concept of airborne surveillance system using a low frequency band (metrik wave length) aimed at: detecting and tracking air targets with low Radar Cross Section (RCS) such as stealth aircraft or missiles, and detecting and localizing moving and non-moving ground targets, possibly hidden under foliage.
Author
Airborne Surveillance Radar; Radar Cross Sections; Low Frequencies

19990054236 Oxford Univ., Mathematical Inst., Oxford, UK
A Linear Programming Approach to Radio Channel Assignment in Heavily Loaded, Evolving Networks
Leese, Robert A., Oxford Univ., UK; Frequency Assignment, Sharing and Conservation in Systems (Aerospace); January 1999, pp. 18-1 - 18-10; In English; See also 19990054217; Sponsored in part by the UK Radiocommunications Agency under a contract with St. Catherines College, Oxford.; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper investigates a possible approach to the radio channel assignment problem, based on linear programming relaxation, together with column generation. The method is tested on a set of benchmarks that are expected to be challenging, and most cases are handled well. Those that are not suggest possible improvements. The method becomes more attractive when there are multiple channel demands at each transmitter site. Attention is restricted to minimum span problems, with interference controlled by a constraint matrix, but similar approaches are possible for more general formulations.
Author
Linear Programming; Frequency Assignment; Network Analysis

19990054312 Naval Postgraduate School, Monterey, CA USA
Localization of Wireless Emitters Based on the Time Difference of Arrival (TDOA) and Wavelet Denoising
Hippenstiel, Ralph D.; Ha, Tri T.; Aktas, Unal; May 1999; 67p; In English
Contract(s)/Grant(s): N41756-98-WR-87397
Report No.(s): AD-A363100; NPS-EC-99-006; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The localization of mobile wireless communication units using time difference of arrival (TDOA) is studied. The wavelet transform is used to increase the accuracy of TDOA estimation. Several denoising techniques based on the wavelet transform are presented. These techniques are applied to different types of test signals and to a simulated baseband GSM signal. The results of the denoising techniques are compared to the ones employing no denoising in terms of the mean square error. The denoising techniques allow a 28 to 81 percent improvement in the TDOA estimation.
DTIC
Signal Processing; Noise Reduction; Radiotelephones; Communication Equipment; Wavelet Analysis

19990054313 Naval Research Lab., Radar Analysis Branch, Washington, DC USA
Hybrid Version of Method of Moments Computer Code: IBC3D
Taylor, Douglas; May 20, 1999; 21p; In English
Report No.(s): AD-A363074; NRL/MR/5310--99-8378; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

IBC3D is a computer program used to calculate the electromagnetic scattering cross section and electric/magnetic surface currents for arbitrary 3-dimensional bodies coated with anisotropic lossy materials. An enhanced version of this code, developed by the Radar Division of the Naval Research Laboratory (NRL), is described here that allows one to generate a hybrid scattering solution by incorporating surface currents generated external to the IBC3D. The benefit derived from using the hybrid approach is gained by reducing the number of surface current unknowns required to produce a scattering cross section using numerically intensive computer codes such as IBC3D. When compared to the unmodified IBC3D solution for a 5-sided prism shaped object a 20 percent reduction in the number of electric surface current unknowns was obtained using the hybrid version of the code with minimal sacrifice in accuracy.
DTIC
Electromagnetic Scattering; Radar Cross Sections; Computer Programs; Scattering Cross Sections

19990054319 Farr Research, Albuquerque, NM USA
Multi-Channel Impulse Radiating Antennas with Polarization Diversity ***Final Report, May 1998 - Jan. 1999***
Farr, Everett G.; Bowen, Leland H.; Baum, Carl E.; Prather, William D.; Jan. 1999; 31p; In English
Contract(s)/Grant(s): F29601-98-C-0166; AF Proj. 3005
Report No.(s): AD-A363740; AFRL-DE-NM-TR-1999-1019; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The tri-impulse radiating antenna (IRA) and quad-IRA are derived here from earlier versions of Impulse Radiating Antennas. In the new designs, the aperture is divided into three, four, or more sections to provide at least two receive channels and at least

one transmit channel, all within a very compact structure. The two receive channels allow reception in two orthogonal polarizations. This configuration is useful when searching for mines using the so-called ”vampire” radar signature. This signature is a characteristic of certain manmade objects in certain symmetry configurations. Such objects cannot scatter any cross-polarized field, whereas natural objects scatter a stronger cross-polarized field component. In this report the radiated fields of the tri-IRA and quad-IRA are analyzed. The feed impedance is optimized and a model tri-IRA is built and tested in various configurations and compared to theoretical predictions.
DTIC
Impulses; Cross Polarization; Antenna Radiation Patterns

19990054450 Helsinki Univ. of Technology, Lab. of Telecommunications Technology, Espoo, Finland
Efficient Simulation Techniques for Multiservice Loss Systems
Lassila, P.; Jan. 1999; ISSN 951-22-4434-9; 112p; In English
Report No.(s): PB99-147415; ISBN 1455-5751; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Modern broadband networks have been designed to integrate several service types into the same network. On the call scale, the process describing the number of calls present in the network can be modeled by a loss system. In principle, loss systems are mathematically simple and well understood, and one is able to write down exact expressions for such things as the blocking probability of a call belonging to a given class. However, for systems of realistic size in terms of the number and the capacity of the links and the number of traffic classes, such analytical expressions defy a direct evaluation because of the huge size of the state space.
NTIS
Losses; Computerized Simulation; Communication Networks; Computer Networks; Network Analysis

33
ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also 60 Computer Operations and Hardware and 76 Solid-State Physics.

19990053549 University of Electro-Communications, Dept. of Applied Physics and Chemistry, Tokyo, Japan
Development of an Annular Array Ultrasonic Transducer for Clinical Investigation
Yamagami, Hiroyuki, University of Electro-Communications, Japan; Ochiai, Tsutomu, University of Electro-Communications, Japan; Goto, Hiroya, University of Electro-Communications, Japan; Sasaki, Yukihiko, University of Electro-Communications, Japan; Bulletin of the University of Electro-Communications; December 1998; Volume 11, No. 2, pp. 145-156; In Japanese; See also 19990053546; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

We have developed ail ultrasonic transducer for clinical investigations, customarily called ”annular array ultrasonic transducer”. This transducer which is composed of three annular piezoelectric high-polymer elements has many focuses which can be varied by delaying emitting waves from each element and works at both 15 and 30 MHz. These transducers used in home-made instrument’s are widely available in clinical fields of ophthalmology, dermatology and orthopedics. In the present paper, the designs and simulations of the transducer, results of essential measurements and some clinical images are given and discussed.
Author
Fabrication; Ultrasonic Wave Transducers; Clinical Medicine

19990053551 University of Electro-Communications, Dept. of Electronic Engineering, Tokyo, Japan
Improvement of Forth Inner Structure about Implementability
Takahashi, Mitsuo, University of Electro-Communications, Japan; Tanaka, Kiyoomi, University of Electro-Communications, Japan; Bulletin of the University of Electro-Communications; December 1998; Volume 11, No. 2, pp. 161-167; In Japanese; See also 19990053546; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

In the ”electronics experiment” class, there is an experiment problem called ”logic circuit” which made the trade-off problem of hardware and software in the design into a subject. Forth language was adopted, because the experiment is made by attention to hierarchy and modularity, The cluster of words of Forth language is called a dictionary and programming is the making of words, with respect to routines of which having one arranged function. When Forth language is compiled, threaded code, address information linked to words, is created and the threaded code is executed by the interpreter. The portability of the dictionary was improved by using compiler and discompiler. Generally, an interpreter has been added to each word. However, each word was defined as a function of C language in the implementation, and the interpreter, a mechanism which called functions, was defined as the main

function. This mechanism is convenient for implementing the execution routine into the firmware. The input/output word was built in using the file control of UNIX OS.
Author
Software Engineering; Forth (Programming Language); Computer Programs; Compilers; Computers

19990053569 Naval Undersea Warfare Center, Newport, RI USA
EMI Measurement Testing Performed at Hanscom Air Force Base and Fort Devens Reserve for the DARPA Hybrid Electric Vehicle Program
Rydzaj, Thomas; Bruno, Anthony B.; Zelaya, Oscar R.; Mar. 01, 1999; 24p; In English
Report No.(s): AD-A362952; NUWC-NPT-TD-11082; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this study, various electric vehicles were tested to evaluate their potential electromagnetic interference (EMI) emissions when used in today's hostile commercial electromagnetic environment. The risks associated with particular emissions were assessed, including the possibility of the electric vehicle creating undesirable EMI emissions that could affect other systems. EMI emissions were measured on both military and civilian vehicles in an effort to build a database that can be used to identify EMI issues that affect electric vehicle performance.
DTIC
Electromagnetic Interference; Electric Motor Vehicles

19990053570 Cornell Univ., Ithaca, NY USA
(DURIP 97) Vacuum Equipment for Ultra High Power Microwave Experiments ***Final Report, 1 Mar. 1997 - 28 Feb. 1999***
Nation, John A.; Apr. 22, 1999; 13p; In English
Contract(s)/Grant(s): F49620-97-1-0112; AF Proj. 3484
Report No.(s): AD-A362954; AFRL-SR-BL-TR-99-0118; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The high vacuum insulator system we obtained did not eliminate the pulse shortening previously observed. However we did eliminate the pulse shortening, albeit with serendipity leading the way. In this case we found no pulse shortening even at 85 MW with poor vacuum. It is worth special note that the 85 MW was achieved at an rf conversion efficiency of 55%. we will now push this limit until we do get shortening and then try again.
DTIC
Vacuum Systems; Microwaves; Ultrahigh Vacuum

19990053584 Ljubljana Univ., Fakultete za Elektrotehniko, Yugoslavia
Electrotechnical Review, Volume 65 ***Elektrotehniski Vestnik, Letnik 65***
Zajc, Baldomir, Editor, Ljubljana Univ., Yugoslavia; Solina, Franc, Editor, Ljubljana Univ., Yugoslavia; 1998; ISSN 0013-5852; In English; In Slovene; See also 19990053585 through 19990053590; No Copyright; Avail: Issuing Activity (Elektrotehniski Vestnik, Fakulteta za Elektrotrhniko, Trzaska 25, 1001Ljubljana, Slovenia), Hardcopy, Microfiche

Contents include the following: Parallel active power filter operating with variable switching frequency. Simulation model of SF6 circuit-breaker for digital simulations of switching transients. Measurement of stray no-load losses in induction motors. Hundred years of particle accelerators. Adaptive routing strategies using learning automata. and Multimedia communications requirements.
CASI
Particle Accelerators; Induction Motors; Frequencies; Digital Simulation; Circuit Breakers; Automata Theory

19990053585 Ljubljana Univ., Faculty of Electrical Engineering, Yugoslavia
Parallel Active Power Filter Operating With Variable Switching Frequency ***Paralelni Aktivni Mocnostni Filter s Spremenljivo Stilalno Frekvenco***
Voncina, Danijel, Ljubljana Univ., Yugoslavia; Nastran, Janez, Ljubljana Univ., Yugoslavia; Electrotechnical Review; 1998; Volume 65, Nos. 2-3, pp. 69-75; In English; See also 19990053584; No Copyright; Avail: Issuing Activity (Elektrotehniski Vestnik, Fakulteta za Elektrotrhniko, Trzaska 25, 1001Ljubljana, Slovenia), Hardcopy, Microfiche

A parallel active power filter for non-linear loads, its signal processing unit for single- and three-phase application, control principle and power stages are described. The filter current reference determination method, which provides reduction of the fundamental reactive power and harmonic distortion for variable non-linear loads, is based on the combined analogue and digital signal processing. First, the load current is filtered by a precision analogue circuit. The further calculation of the filter current references in a single- and three-phase application is accomplished by microcontrollers MC68HC11 and MC68332. The implemented discrete-time triggering method and selected reactive elements in the filter's power stage provide fast response of the actual filter

current to its reference. The results, obtained from the experimental circuits, illustrate the active filter performance hl steady state and during load current transients.
Author
Switching; Circuits; Frequencies; Nonlinearity; Signal Processing; Electric Filters

19990053586 Ljubljana Univ., Fakultete za Elektrotehniko, Yugoslavia
Simulation Model of SF6 Circuit-Breaker for Digital Simulations of Switching Transients ***Simulacijski Model Odklopnika SF6 za Potrebe Digitalne Simulacije Stikalnih Prehodnih Pojavov***
Bizjak, Grega, Ljubljana Univ., Yugoslavia; Povh, Dusan, Siemens A.G., Germany; Zunko, Peter, Ljubljana Univ., Yugoslavia; Electrotechnical Review; 1998; Volume 65, Nos. 2-3, pp. 84-92; In Slovene; See also 19990053584; No Copyright; Avail: Issuing Activity (Elektrotehniski Vestnik, Fakulteta za Elektrotrhniko, Trzaska 25, 1001Ljubljana, Slovenia), Hardcopy, Microfiche

The paper describes the development and testing of detailed model of a high voltage SF6 circuit-breaker for digital simulation programs. THe model of the SF6 circuit-breaker is a black-box model introduced in the modelled system in a form of two-pole element with a variable impedance assured by a special regulator-mathematical model.It consists of four partial models combined together: closed circuit-breaker model, burning arc model, current zero crossing model and open circuit-breaker model are then shown.
Author
Digital Simulation; Computerized Simulation; Circuit Breakers; Fabrication; Performance Tests; High Voltages

19990053587 Koncar, Inst. za Elektrotehniko, Osijek, Croatia
Measurement of Stray No-Load Losses in Induction Motors ***Meritev Dodatnih Izgub Prostega Teka Trifaznih Asinhronskih Motorjev***
Stefanko, Stjepan, Koncar, Croatia; Zagradisnik, Ivan, Maribor Univ., Slovenia; Gajzer, Matej, Maribor Univ., Slovenia; Slemnik, Bojan, Maribor Univ., Slovenia; Electrotechnical Review; 1998; Volume 65, Nos. 2-3, pp. 102-107; In Slovene; See also 19990053584; No Copyright; Avail: Issuing Activity (Elektrotehniski Vestnik, Fakulteta za Elektrotrhniko, Trzaska 25, 1001Ljubljana, Slovenia), Hardcopy, Microfiche

In induction motors at no-load stray no-load losses are present besides fundamental losses (stator winding losses, stator fundamental frequency core losses, friction and windage losses). The stray no-load losses are mostly located in the stator and rotor core laminations (surface and pulsation losses) and in the rotor winding. Also, in squirrel-cage induction motors with skewed rotor slots, there are losses due to the crossbar currents. The main part of the stray no-load losses are caused by the permeance waveform of the airgap due to slotting and the smaller part caused by the saturation of the main magnetic paths in the induction motor. The presentation of the permeance harmonics, due to slotting in the flux-density waveform, is described in Section 2. Also the excitation harmonics of the stator and rotor winding are given in this section. For the product of the same order harmonics of the excitation and the permeance the airgap induction is given. In Section 3, the paper describes a measurement method of stray no-load losses, known as the hysteresis jump. From the energy balance at the hysteresis jump the voltage depending stray no-load losses can be obtained.
Author
Electric Control; Electric Potential; Slots; Rotors; Magnetic Induction; Harmonic Excitation

19990053733 Space and Naval Warfare Systems Center, San Diego, CA USA
Characterization of a Hard-Switching Motor Controller for EMC Considerations
Li, S. T.; McGee, J. B.; Schukantz, J. H.; Mar. 1999; 32p; In English
Report No.(s): AD-A362721; SSC-TD-3068; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The overall objective of this research is to characterize Power Electronic Building Blocks (PEBBs) for application of electromagnetic compatibility (EMC) in existing and advanced shipboard electric power systems. Both emissions and susceptibility levels will be studied, first for radiated EMI and later for conducted EMI. The EMI suppression techniques in large and small high-density power electronic modules will be developed. This document presents the results of the initial efforts toward the overall research objective. These initial efforts include setting up the EMI measurement facilities, developing EMI measurement techniques, and performing radiated emission tests on a motor controller, which is a hard-switching device.
DTIC
Thyristors; Electromagnetic Compatibility; Electric Power Supplies; Electronic Modules

19990053743 Honeywell Technology Center, Minneapolis, MN USA

Optical Interconnect Technology (OIT) Multichip Module to Multichip Module ***Final Report, 13 Aug. 1992 - 30 Jun. 1996***

Bristow, Julian; Liu, Yue; Johnson, Klein; Jan. 1998; 53p; In English

Contract(s)/Grant(s): F33615-92-C-1034; AF Proj. 2001

Report No.(s): AD-A362637; C-98057; AFRL-SN-WP-TR-1998-1055; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We have successfully demonstrated the first MCM-to-board-to-MCM optical interconnect based on VCSELs, polymer waveguide, and MCM-C packaging technologies. We demonstrated low-cost component fabrication and passive assembling techniques that are compatible with existing electronic manufacturing processes. We believe these approaches are critical to optical insertion into real system applications. We fabricated flexible polymer waveguide ribbons, board-integrated optical waveguides, and passively aligned flex-to-board waveguide connectors. We also demonstrated optical links based on conventional MCM-C packages with multiple data channels at data rates up to 1 Gbps per channel.

DTIC

Optical Interconnects; Channels (Data Transmission); Chips (Electronics)

19990053782 Boeing Defense and Space Group, Research and Technology Div., Seattle, WA USA

Electromagnetic Effects of Advanced Packaging ***Final Report, Nov. 1994 - Oct. 1998***

Erickson, Grant, Boeing Defense and Space Group, USA; Badger, Scott, Boeing Defense and Space Group, USA; Mar. 1999; 216p; In English

Contract(s)/Grant(s): F30602-94-C-0085; AF Proj. 2338

Report No.(s): AD-A362900; AFRL-IF-RS-TR-1999-50; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

Advanced packaged technology devices are providing improved performance characteristics in airborne, spaceborne, and land-based tactical military operations. Modern packaging technologies are also contributing to improved commercial systems performance. With the proliferation of these systems, their densely populated electromagnetic environments can result in electromagnetic susceptibility threats from within the packaging as well as from external sources. As a consequence, it is important that susceptibilities to electromagnetic environments be addressed early in the design and that these considerations include packaging design as well as circuit design. This document is the final scientific and technical report submitted under the Electromagnetic Effects on Advanced Packaging Contract F30602-94-C-0085. The purpose of this contract is to assist the US Air Force Research Laboratory, Rome Research Site in determining electromagnetic effects on advanced packaged devices and in determining evaluation models to identity, predict, and minimize electromagnetic effects on the reliability of devices and systems. The work was performed at the Boeing Space Center in Kent, Washington.

DTIC

Electromagnetic Compatibility; Radio Frequency Interference; Electronic Countermeasures

19990053804 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Ultra-Wideband TEM Horns, Transient Arrays and Exponential Curves: A FDTD Look

Utton, Troy S.; Mar. 1999; 133p; In English

Report No.(s): AD-A361787; AFIT/GE/ENG/99M-29; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This research investigates the possibility of applying exponentially curved conducting plates to single-element Transverse Electromagnetic (TEM) horns and their transient arrays to enhance the UWB characteristics already experienced by these radiators. The first part of this study demonstrates the Finite-Difference Time-Domain (FDTD) method's ability to duplicate experimental data, and establishes the baseline models used throughout the remainder of the research. The baseline models consist of the typical flat-triangle shaped conducting plates. The exponential taper models incorporate the exponential curves in the height, the width, and both the height and width directions. One, two- and four-element baseline configurations are compared to their respective exponential-curved models. The comparisons are made in both the time-domain and the frequency-domain. The research concludes that reflection are not reduced by the application of exponential curves, but that the curves can increase or decrease the peak field strength depending on the input pulse width and the direction to which the curve is applied. This research also demonstrates, with the FDTD method, the major benefits realized when transient arrays are constructed from these elements. The final product of this research results from the exploration of methods to reduce FDTD run-times of these types of problems. The run-times are reduced by 96%, and approach the run-times necessary for interfacing the FDTD method with an optimizing algorithm.

DTIC

Finite Difference Time Domain Method; Antenna Arrays; Horn Antennas; Finite Difference Theory; Systems Analysis; Computational Electromagnetics; Time Domain Analysis

19990053810 Institute of Optoelectronics S.A., Bucharest, Romania

Fifth Symposium on Optoelectronics (SIOEL 1998)

Necsiou, Teodor; Jan. 1999; 284p; In English, 23-25 Sep. 1998, Bucharest, Romania

Contract(s)/Grant(s): F61775-98-W-E022

Report No.(s): AD-A361751; EOARD-CSP-98-1038; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

The Final Proceedings for The 5th Symposium on Optoelectronics, September 23, 1998 - September 25, 1998. This is an interdisciplinary conference. Topics include materials and components for optoelectronics, new components, analysis and control methods for fabrication of optoelectronic devices and materials, and optoelectronic applications.

DTIC

Conferences; Electro-Optics; Optoelectronic Devices

19990053825 Communications Research Lab., Tokyo, Japan

Superconducting Device Technology and High Frequency Application

Wang, Zhen, Communications Research Lab., Japan; Kawakami, Akira, Communications Research Lab., Japan; Shimakage, Hisashi, Communications Research Lab., Japan; Uzawa, Yoshinori, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 625-636; In Japanese; See also 19990053822; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

In this paper, we report on progress in fabrications of superconducting Josephson junctions and applications in millimeter and submillimeter wave regions. NbN/AlN/NbN tunnel junctions have been developed with very high current density up to 54 kA/sq cm. The junctions showed good Josephson tunneling behavior, excellent terahertz response, and sensitive heterodyne mixing properties. We have fabricated YBCO step-edge Josephson junctions with an Au thin-film shunted resistance and a log-periodic antenna for applications as submillimeter wave Josephson mixers. The best receiver noise temperature of 1,200 K was achieved in the 300-GHz band, and the harmonic mixing and self-pumping mixing phenomena were studied in the submillimeter wave region. In order to improve the high frequency performance of Josephson array oscillators, we developed a shunted tunnel junction with a very small parasitic inductance and fabricated Josephson array oscillators. Resonant properties of resistance shunted tunnel junctions have been investigated and the output power and linewidth of the oscillators was estimated in the submillimeter wave regions.

Author

Technology Utilization; Superconducting Devices; High Frequencies; Fabrication; Josephson Junctions; Submillimeter Waves; Millimeter Waves; YBCO Superconductors

19990053865 Centre National d'Etudes Spatiales, Toulouse, France

Original Piezomotor for Space Applications

Six, Marc-F., Centre National d'Etudes Spatiales, France; Thomin, Georges, Centre National d'Etudes Spatiales, France; Berthier, Yves, Institut National des Sciences Appliquees de Lyon, France; LeLetty, Ronan, Cedrat Recherche, France; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 151-156; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

An innovative linear piezomotor developed by Cedrat Recherche answers to high positioning needs of space applications: no lubrication, large blocking force at rest, and better than 1 micron accuracy. Taking care especially of tribological aspects in their realization, tested piezomotors have achieved steady performances along their life time both in air and in vacuum; they can maintain a driving force of 20 N during 500,000 actuations over a 3-mm stroke.

Author

Technology Utilization; Piezoelectricity; Servomotors; Electromechanical Devices

19990053871 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Motor Brush Testing for Mars and Vacuum

Noon, Don E., Jet Propulsion Lab., California Inst. of Tech., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 187-196; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

Brush motors have been qualified and flown successfully on Mars missions, but upcoming missions require longer life and higher power. A test program was therefore undertaken to identify the best brush material for operation in the Mars atmosphere. Six different brush materials were used in 18 identical motors and operated under various load conditions for a period of four weeks in low-pressure CO2. All motors performed acceptably, with accumulated motor revolutions between 98 and 144 million revolutions, depending on load. A proprietary silver-graphite material from Superior Carbon (SG54-27) appears to be the best choice for long life, but even the stock copper-graphite brushes performed reliably with acceptable wear. The motors from the CO2 test

were then cleaned and run in vacuum for 2 weeks. The difference in results was dramatic, with 5 motors failing catastrophically and wear rates increasing by orders of magnitude for the SG54-27 material. Three brush materials survived the test with no failures: SG54-27 with a proprietary Ball Aerospace impregnation, a silver-graphite-molybdenum disulfide material from Superior Carbon (SG59), and a copper sulfide-graphite material also from Superior Carbon (BG91).
Author
Electric Motors; Brushes (Electrical Contacts); Performance Tests; Mars (Planet); Environmental Tests; Vacuum Tests; Construction Materials

19990053891 Department of the Navy, Washington, DC USA
Continuous-Time Adaptive Learning Circuit
Kub, Francis J., Inventor; Justh, Eric W., Inventor; Jul. 14, 1998; 9p; In English
Patent Info.: Filed 6 Nov. 95,; US-Patent-Appl-SN-554-160; US-Patent-5,781,063
Report No.(s): AD-D019309; No Copyright; Avail: US Patent and Trademark Office, Microfiche

An integrator-multiplier-integrator circuit scheme usable in transverse filters, a transverse filter employing such a circuit, and a method for using each. The multiplier-integrator multiplier has a capacitatively loaded integrating amplifier fed by a transistor. The current through the transistor, and hence the time it takes to charge the integrating capacitor, depends largely on the bias of the transistor, not the size of the capacitor, permitting one to set and control integration time by setting the transistor's parameters, and controlling its bias, effectively controlling integration time by us of only one semiconductor device. An additional circuit for autozeroing (i.e., canceling quiescent offset) increases adaptivity of the circuit. Preferably the phase of inputs to the first multiplier is made selectably variable to minimize phase difference at the multiplier, thus increasing circuit stability.
DTIC
Integrated Circuits; Adaptive Filters; Circuits; Bias

19990053895 Department of the Navy, Washington, DC USA
Single Electron Digital Circuits
Ancona, Mario G., Inventor; Nov. 17, 1998; 12p; In English; Supersedes US-Patent-Appl-SN-773155
Patent Info.: Filed 26 Dec. 96,; US-Patent-5,838,021; US-Patent-Appl-SN-773,155
Report No.(s): AD-D019316; No Copyright; Avail: US Patent and Trademark Office, Microfiche

Disclosed are single electron digital devices, in which the screening lengths of individual device islands are between 0.5 and 1.0 islands. This range permits island occupancy to be bias independent, permitting the devices to hold or process digital information independent of device biases. This range of screening lengths can be effected by choice of device parameters which are sufficiently modest to permit practical fabrication of these devices.
DTIC
Digital Systems; Digital Data; Electronic Equipment

19990053896 Department of the Navy, Washington, DC USA
Hold-Up Circuit with Safety Discharge for Preventing Shut-Down by Momentary Power Interruption
Saadeh, Tobia, Inventor; Oct. 27, 1998; 6p; In English; Supersedes US-Patent-Appl-SN-49463
Patent Info.: Filed 20 Apr. 93,; US-Patent-5,828,207; US-Patent-Appl-SN-49,463
Report No.(s): AD-D019317; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a storage capacitor of a hold-up circuit is connected by a resistor to the current conducting bus supplying operating voltage to computer hardware from a power source. The capacitor is thereby charged to the operating voltage level in order to subsequently maintain computer operation by discharge through a diode during power interruption of a relatively long duration determined by the capacitor charge and a predetermined drop in voltage applied to the computer load causing its shutdown. Detection of such drop in voltage is operative through an opto-isolator to safely discharge the capacitor by relay controlled grounding thereof.
DTIC
Capacitors; Electric Potential; Resistors; Shutdowns; Safety; Diodes

19990053897 Department of the Navy, Washington, DC USA
Transformer Which uses Bi-Directional Synchronous Rectification to Transform the Voltage of an Input Signal Into an Output Signal Having a Different Voltage and Method for Effectuating Same
Hammond, Russell E., Inventor; Johnson, Leopold J., Inventor; Sep. 29, 1998; 11p; In English; Supersedes US-Patent-Appl-SN-855689

Patent Info.: Filed 14 May 97,; US-Patent-5,815,384; US-Patent-Appl-SN-855,689
Report No.(s): AD-D019322; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The present invention provides a transformer which uses bi-directional synchronous rectification to transform the voltage of an input signal from one voltage level to another. The invention provides a transformer which requires less core volume, and hence mass, than conventional transformers, and includes a rectifier for transforming a first time varying input signal, such as a sinusoid or saw tooth signal, into a full-wave rectified voltage signal. A synchronous switch control generates first and second control signals in response to sampling the first time varying voltage signal. A floating drive buffer generates third control signals in response to receiving the second control signals. An AC switching stage transforms the full-wave rectified voltage signal into a first and second series of voltage pulses in response to receiving the first control signals. Each of the first and second series of voltage pulses has a pulse period, T, and a pulse width, omega. The first and second series of voltage pulses have amplitudes generally corresponding to the amplitude of the first time varying voltage signal. In response to receiving the second control signals, a bi-directional synchronous rectifier transforms the first and second series of voltage pulses into a third series of voltage pulses having time varying amplitudes generally corresponding to the amplitude of the first time varying voltage signal, a pulse period T/2, and a pulse width, omega. A low pass smoothing filter transforms the third series of voltage pulses into a second time varying analog voltage signal.

DTIC

Pulse Duration; Electric Potential; Low Pass Filters; Rectification

19990053898 Department of the Navy, Washington, DC USA

Squirrel Cage Type Electric Motor Rotor Assembly

Cho, Chahee P., Inventor; Krol, William P., Jr, Inventor; Oct. 06, 1998; 5p; In English
Patent Info.: Filed 5 Sep. 96,; US-Patent-Appl-SN-706,593; US-Patent-5,818,141
Report No.(s): AD-D019323; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a squirrel cage type electric motor rotor assembly includes first and second end plates of circular configuration, rigid tubes extending from the first plate to the second plate, the tubes being closed a either end thereof to define enclosed chambers therein, and granules of magnetic material disposed in the chambers, the granules being packed therein with a density leaving them readily movable to align with magnetic fields.

DTIC

Electric Motors; Magnetic Materials; Circular Tubes

19990054111 NASA Langley Research Center, Hampton,VA USA

Design of Advanced Atmospheric Water Vapor Differential Absorption Lidar (DIAL) Detection System

Refaat, Tamer F., Old Dominion Univ., USA; Luck, William S., Jr., NASA Langley Research Center, USA; DeYoung, Russell J., NASA Langley Research Center, USA; Jul. 1999; 42p; In English
Contract(s)/Grant(s): RTOP 622-63-13-70
Report No.(s): NASA/TP-1999-209348; L-17871; NAS 1.60:209348; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The measurement of atmospheric water vapor is very important for understanding the Earth's climate and water cycle. The lidar atmospheric sensing experiment (LASE) is an instrument designed and operated by the Langley Research Center for high precision water vapor measurements. The design details of a new water vapor lidar detection system that improves the measurement sensitivity of the LASE instrument by a factor of 10 are discussed. The new system consists of an advanced, very low noise, avalanche photodiode (APD) and a state-of-the-art signal processing circuit. The new low-power system is also compact and lightweight so that it would be suitable for space flight and unpiloted atmospheric vehicles (UAV) applications. The whole system is contained on one small printed circuit board (9 x 15 sq cm). The detection system is mounted at the focal plane of a lidar receiver telescope, and the digital output is read by a personal computer with a digital data acquisition card.

Author

Atmospheric Moisture; Water Vapor; Design Analysis; Differential Absorption Lidar; Detection

19990054158 Department of the Navy, Washington, DC USA

System for Determining Time Between Events Using a Voltage Ramp Generator

McDonald, Vincent K., Inventor; Olson, Jack R., Inventor; Sotirin, Barbara J., Inventor; Williams, Robert B., Inventor; Sep. 01, 1998; 9p; In English; Supersedes US-Patent-Appl-SN-527740
Patent Info.: Filed 13 Sep. 95,; US-Patent-Appl-SN-527,740; US-Patent-5,801,560
Report No.(s): AD-D019336; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a system for determining the time between the receipt of two different signals, includes a voltage ramp generator which generates a time dependent voltage signal upon receipt of a timing pulse at a time T1, and provides the instantaneous value of the voltage signal when the voltage ramp generator receives an input signal having a predetermined threshold value at time T2. A data processor coupled to receive the voltage signal, generates the timing pulse, and determines a time difference delta T from the voltage signal, where AT=T2-T1.
DTIC
Time Dependence; Voltage Generators; Electric Potential

19990054161 Department of the Navy, Washington, DC USA
Illuminating Electrical Fuse
Moody, Paul E., Inventor; Dec. 21, 1998; 13p; In English
Patent Info.: Filed 21 Dec. 1998; US-Patent-Appl-SN-9,226,620
Report No.(s): AD-D019340; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche
An illuminating electrical fuse having an indicator lamp is provided. The indicator lamp is connected to the fuse element on the load side of the circuit and to an independent ground. During operation of the fuse, the lamp is illuminated. When the fuse blows out, the lamp is extinguished. The configuration of the circuit places the lamp in parallel with the circuit load in contrast to similar fuses having the lamp, fuse element and load in series. With the lamp in parallel, lamp failure does not shut down the circuit. Further, the current draw of the electrical load bypasses the lamp circuit through which only a small current passes. The lamp in the preferred embodiment is a light emitting diode.
DTIC
Light Emitting Diodes; Illuminating; Circuits

19990054163 Department of the Navy, Washington, DC USA
Electrical Outlet Splash Protector
Moody, Paul E., Inventor; Dec. 21, 1998; 23p; In English
Patent Info.: Filed 21 Dec. 1998; US-Patent-Appl-SN-09,226,614
Report No.(s): AD-D019342; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche
A splash protector in combination with an electrical outlet includes a shield member having a first shield portion and a second shield portion opposite to the first shield portion. A spring member is provided in connection with the first and second shield portions. An outlet cover includes an outer face with a pair of rectangular slot openings and a grounding pin opening formed therein, and an inner face having a recessed area with an outer perimeter of the recessed area encompassing at least the pair of rectangular slot openings and grounding pin opening, but less than an outer dimension of the outlet cover. A spring-supporting post is formed on the inner face of the outlet cover and projecting therefrom such that the spring member fits within facing inner sides of the first and second shield portions so that the first and second shields completely block external access to the rectangular slot openings and grounding pin opening of the outlet cover. Upon selectively actuating the spring, the shield portions are moved away from the rectangular slot openings and grounding pin opening.
DTIC
Safety; Electrical Grounding; Slots

19990054168 Department of the Navy, Washington, DC USA
Channelized Receiver-Front-End Protection Circuit Which Demultiplexes Broadband Signals into a Plurality of Different Microwave Signals in Respective Contiguous Frequency Channels, Phase Adjusts and Multiplexes Channels
Rauscher, Christen, Inventor; Nov. 17, 1998; 14p; In English; Supersedes US-Patent-Appl-SN-674951
Patent Info.: Filed 3 Jul. 96,; US-Patent-5,838,675; US-Patent-Appl-SN-674,951
Report No.(s): AD-D019300; No Copyright; Avail: US Patent and Trademark Office, Microfiche
The invention pertains to a channelized protection circuit for protecting the front-end of a receiver from the detrimental effects of interference signals within the bandwidth of received signals is disclosed. The channelized protection circuit comprises: a frequency demultiplexer for separating a broadband input signal into a plurality of different signal components in respective contiguous frequency channels; a plurality of signal conditioning sub-circuits respectively responsive to the plurality of different signal components for selectively performing a conditioning operation on the plurality of different signal components to produce a plurality of conditioned signal components minimally affected by interference signals from within any of the contiguous frequency channels; and a frequency multiplexer having a plurality of contiguous frequency channels for recombining the plurality of conditioned signal components into a composite conditioned signal of original bandwidth and at a safe power level with a minimum amount of interference. Preferably, the channelized protection circuit also includes a first plurality of phase-adjusting cir-

cuits for compensating for phase imbalances among the plurality of different signal components, and also includes a second plurality of phase-adjusting circuits for compensating for phase imbalances among the plurality of conditioned signal components.
DTIC
Signal Processing; Channel Flow; Demultiplexing; Bandwidth; Broadband

19990054175 Department of the Navy, Washington, DC USA
Switching Matrix
Hovey, John M., Inventor; Parker, Carlyle V., Inventor; Oct. 06, 1998; 9p; In English; Supersedes
Patent Info.: Filed 22 Nov. 72,; US-Patent-Appl-SN-308,630; US-Patent-5,818,940
Report No.(s): AD-D019333; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a deciphering unit having input and output matrices connected to a master shift register to permit flexible access to its stages. The output matrix allows selection of four register positions in the master shift register from which data is fed to a correspondence generator where it is partially descrambled. Subsequently, the input matrix allows selection of four input register positions for the partially descrambled data, and one input register position for serial key shift register data. A comparison matrix selects eight bit positions to allow comparison of the descrambled master shift register data with a predetermined eight hit word. Upon favorable comparison a four bit word is transmitted to a base interrogating station for identification. Also, the same apparatus can be used for enciphering by shifting the data in the master shift register in a reverse manner.
DTIC
Shift Registers; Switching Circuits; Matrices (Circuits)

19990054195 Sandia National Labs., Albuquerque, NM USA
Mechanisms of heavy-ion induced gate rupture in thin oxides
Sexton, F. W.; Fleetwood, D. M.; Krisch, K. S.; Dec. 31, 1998; 2p; In English; IEEE semiconductor interface specialists conference
Report No.(s): DE98-006158; SAND-98-1899C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Single event gate rupture (SEGR) is a catastrophic failure mode that occurs in dielectric materials that are struck by energetic heavy ions while biased under a high electric field condition. SEGR can reduce the critical electric field to breakdown to less than half the value observed in normal voltage ramp reliability tests. As electric fields in gate oxides increase to greater than 5 MV/cm in advanced MOS technologies, the impact of SEGR on the reliability of space based electronics must be assessed. In this summary, the authors explore the nature of SEGR in oxides with thickness from 7 nm to less than 5 nm, where soft breakdown is often observed during traditional reliability tests. They discuss the possible connection between the present understanding of SEGR and voltage stress breakdown models.
NTIS
Dielectrics; Capacitors; Silicon Oxides; Electrical Faults; Radiation Effects

19990054583 National Central Univ., Dept. of Electrical Engineering, Chung-Li, Taiwan, Province of China
Transient Simulation of an A-Si TFT/LCD Pixel Using Table-Modeling Techniques
Tsai, Yao-Tsnug, National Central Univ., Taiwan, Province of China; Yang, Wen-Hong, National Central Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 87-92; In English
Contract(s)/Grant(s): NCHC-86-03-009; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper presents the table-modeling technique for circuit simulation. First, an a-Si TFT analytical model based on its operational physics is presented. The table-modeling technique requires current and capacitance tables for different bias voltages. These tables were obtained from an analytical model. Using pixel simulation, we found that the table-modeling technique is as accurate as the a-Si analytical model for the same given conditions. Second, the 2-D numerical model can be used as a good approximation to simulate an a-Si TFT device. The current and capacitance tables were generated from the 2-D numerical model. The simulation with an the a-Si circuit application using the table-modeling technique was very close to that using the 2-D numerical model. The impact of non-quasi static effect on the table-modeling technique is also discussed.
Author
Computerized Simulation; Semiconductor Devices; Mathematical Models; Two Dimensional Models

19990054588 Aerospace Corp., Technology Operations, El Segundo, CA USA
Moderated Degradation Enhancement of Lateral Pnp Transistors Due to Measurement Bias
Witczak, S. C.; Lacoe, R. C.; Mayer, D. C.; Schrimpf, R. D.; Barnaby, H. J.; May 15, 1999; 9p; In English; Prepared in cooperation

with Vanderbilt Univ., Nashville, TN, RLP Research, Inc., Albuquerque, NM, and Sandia National Lab., Albuquerque, NM.
Contract(s)/Grant(s): F04701-93-C-0094; DE-AC04-94AL85000
Report No.(s): AD-A363794; TR-99(8555)-1; SMC-TR-99-19; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Enhanced low-dose-rate gain degradation of ADI RF25 lateral pnp transistors is examined as a function of the bias at which the gain is measured. Degradation enhancement at low dose rates diminishes rapidly with increasing measurement bias between the emitter and the base. Device simulations reveal that interface trap charging, field effects from oxide trapped charge and emitter metallization, base series resistance and high-level carrier injection all contribute to this behavior. As a practical consequence, accelerated hardness assurance tests of this device require higher irradiation temperatures or larger design margins for low power applications.
DTIC
Radiation Effects; Accelerated Life Tests; Irradiation; Transistors

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FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling. For related information see also 02 Aerodynamics and 77 Thermodynamics and Statistical Physics.

19990052868 Research and Technology Organization, Applied Vehicle Technology Panel, Neuilly-sur-Seine, France
High Order Approximations for Compressible Fluid Dynamics on Unstructured and Cartesian Meshes
Barth, Timothy, Editor, NASA Ames Research Center, USA; Deconinck, Herman, Editor, Von Karman Inst. for Fluid Dynamics, Belgium; March 1999; 582p; In English; Higher Order Discretization Methods in Computational Fluid Dynamics, 14-15 Sep. 1998, Rhode-Saint-Genese, Moffett Field, CA, Belgium, USA; Sponsored by Research and Technology Organization, France
Report No.(s): RTO-EN-5; ISBN 3-540-65893-9; Copyright Waived; Avail: CASI; A25, Hardcopy; A06, Microfiche

The development of high-order accurate numerical discretization techniques for irregular domains and meshes is often cited as one of the remaining challenges facing the field of computational fluid dynamics. In structural mechanics, the advantages of high-order finite element approximation are widely recognized. This is especially true when high-order element approximation is combined with element refinement (h-p refinement). In computational fluid dynamics, high-order discretization methods are infrequently used in the computation of compressible fluid flow. The hyperbolic nature of the governing equations and the presence of solution discontinuities makes high-order accuracy difficult to achieve. Consequently, second-order accurate methods are still predominately used in industrial applications even though evidence suggests that high-order methods may offer a way to significantly improve the resolution and accuracy for these calculations. to address this important topic, a special course was jointly organized by the Applied Vehicle Technology Panel of NATO's Research and Technology Organization (RTO), the von Karman Institute for Fluid Dynamics, and the Numerical Aerospace Simulation Division at the NASA Ames Research Center. The NATO RTO sponsored course entitled "Higher Order Discretization Methods in Computational Fluid Dynamics" was held September 14-18, 1998 at the von Karman Institute for Fluid Dynamics in Belgium and September 21-25, 1998 at the NASA Ames Research Center in the United States. During this special course, lecturers from Europe and the USA gave a series of comprehensive lectures on advanced topics related to the high-order numerical discretization of partial differential equations with primary emphasis given to computational fluid dynamics (CFD). Additional consideration was given to topics in computational physics such as the high-order discretization of the Hamilton-Jacobi, Helmholtz, and elasticity equations. This volume consists of five articles prepared by the special course lecturers. These articles should be of particular relevance to those readers with an interest in numerical discretization techniques which generalize to very high-order accuracy. The articles of Professors Abgrall and Shu consider the mathematical formulation of high-order accurate finite volume schemes utilizing essentially non-oscillatory (ENO) and weighted essentially non-oscillatory (WENO) reconstruction together with upwind flux evaluation. These formulations are particularly effective in computing numerical solutions of conservation laws containing solution discontinuities. Careful attention is given by the authors to implementational issues and techniques for improving the overall efficiency of these methods. The article of Professor Cockburn discusses the discontinuous Galerkin finite element method. This method naturally extends to high-order accuracy and has an interpretation as a finite volume method. Cockburn addresses two important issues associated with the discontinuous Galerkin method: controlling spurious extrema near solution discontinuities via "limiting" and the extension to second order advective-diffusive equations (joint work with Shu). The articles of Dr. Henderson and Professor Schwab consider the mathematical formulation and implementation of the h-p finite element methods using hierarchical basis functions and adaptive mesh refinement. These methods are particularly useful in computing high-order accurate solutions containing perturbative layers and corner singularities. Additional flexibility is obtained using a mortar FEM technique whereby nonconforming elements are inter-

faced together. Numerous examples are given by Henderson applying the h-p FEM method to the simulation of turbulence and turbulence transition.
Derived from text
Computational Fluid Dynamics; Partial Differential Equations; Discretization (Mathematics); Approximation; Unstructured Grids (Mathematics); Galerkin Method; Essentially Non-Oscillatory Schemes; Weighting Functions

19990053797 Defence Science and Technology Organisation, Melbourne Australia
Flow Visualization About the Helicopter Deck of the Hydrographic Ship
Edwards, Craig D., Defence Science and Technology Organisation, Australia; Mar. 1999; 135p; In English
Report No.(s): AD-A362877; DSTO-TR-0762; DODA-AR-010-842; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Flow visualisation tests were performed about the helicopter deck of a 1/35 scale model of the Hydrographic Ship in the Low Speed Wind Tunnel at the Aeronautical and Maritime Research Laboratory. The model was tested over a range of relative wind angles using tuft, smoke and surface flow visualisation techniques to determine regions of adverse airflow that may have a detrimental effect on helicopter-ship operations in order to meet certification requirements. In particular, turbulent flow in the vicinity of the flight deck, vertical replenishment area and the ship's anemometer installation were identified, photographed and recorded on video. Effects of two fixed ship roll angles on the flow were also investigated. This document contains extensive results for all model configurations tested and describes in detail the flow features observed.
DTIC
Flow Visualization; Landing Gear; Landing Instruments; Wind Tunnel Models

19990053808 Boston Univ., Dept. of Aerospace and Mechanical Engineering, Boston, MA USA
Trailing Edge Noise Evaluated at Very Low Mach Number from Incompressible Flow Simulations ***Final Report***
Howe, M. S.; Mar. 09, 1999; 59p; In English
Contract(s)/Grant(s): N00014-98-1-0798
Report No.(s): AD-A361764; AM-99-0003; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A review is made of the diffraction theory of the trailing edge noise generated by a flat-plate airfoil of zero-thickness and non-compact chord, according to which the sound is attributed to the scattering of a 'frozen' pattern of turbulence wall pressure swept over the edge in the mean flow. Extension is made to determine the sound produced by very low Mach number flow over the edge of an airfoil of finite thickness. In applications it is desirable to represent the noise in terms of a surface integral over the airfoil involving a Green's function and a metric of the edge flow that can be calculated locally using the equations of motion of an incompressible fluid. It is argued that the appropriate metric for a rigid airfoil is the incompressible 'upwash' velocity (determined by the Biot-Savart induction formula applied to the boundary layer vorticity outside the viscous sublayer), and not the surface pressure. Formula for calculating the noise are given when the airfoil thickness is acoustically compact, and for both three and two-dimensional edge flows. The theory is illustrated by a detailed discussion of a two-dimensional vortex flow over an airfoil with a rounded trailing edge. The problem is simple enough to be treated analytically, yet is also suitable for validating computational edge noise schemes.
DTIC
Incompressible Flow; Flow Visualization; Computational Fluid Dynamics; Two Dimensional Flow; Aerodynamic Noise; Airfoil Profiles

19990053889 Department of the Navy, Washington, DC USA
Cooling With the Use of a Cavitating Fluid Flow
Ruffa, Anthony A., Inventor; Oct. 06, 1998; 6p; In English; Supersedes , AD-D018595
Patent Info.: Filed 26 Feb. 97,; US-Patent-Appl-SN-812-099; US-Patent-5,816,056
Report No.(s): AD-D019314; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a method and system are provided for cooling a medium. A fluid is moved through the medium and bubbles are induced in the fluid as it moves through the medium. The bubble formation is induced by applying an acoustic field to the fluid as it moves through the medium. A heat sink can be thermally coupled to the fluid downstream of the medium so that heat rejected during bubble contraction and collapse is passed to the heat sink. The pressure of the fluid, i.e., the velocity of the fluid, can also controlled so that the bubbles contract and collapse in the region of the heat sink.
DTIC
Liquid Cooling; Cavitation Flow

19990054318 Moscow Inst. of Physics and Technology, Moscow, Russia
Receptivity of Hypersonic Non-Gradient Boundary Layer to Wall Disturbances ***Final Report***
Fedorov, Alexander V.; May 1999; 76p; In English
Contract(s)/Grant(s): F61775-98-WE039
Report No.(s): AD-A363739; MIPT/FALT-1999-010; EOARD-SPC-98-4036; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Theoretical analysis of hypersonic boundary-layer receptivity to wall disturbances is conducted using a combination of asymptotic and numerical methods. Excitation of the second-mode waves by distributed and local forcing on the flat plate surface is studied under adiabatic and cooled wall conditions. Analysis addresses receptivity to wall vibrations, periodic suction-blowing through a hole or slot, and temperature disturbances. A strong excitation occurs in local regions where forcing is in resonance with normal waves. It is revealed that the receptivity function tends to infinity as the resonance point tends to the branch point of discrete spectrum that is typical for the cooled wall case. Asymptotic analysis resolves this singularity and provides maximal receptivity levels in the branch-point vicinity. Analytical results are integrated into the computational module providing fast estimates of receptivity levels for different types and shapes of wall forcing. Numerical results indicate extremely high receptivity to vibrations and suction-blowing near the lower neutral branch. Critical amplitudes of local and distributed vibrations are estimated for bypass of the linear stability phase. The theoretical model can be used to predict initial amplitudes of unstable waves in active (ascending) flights accompanied by skin vibrations.
DTIC
Boundary Layer Transition; Hypersonic Boundary Layer; Walls

19990054415 Academy of Sciences (USSR), Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR
Hypersonic Crossing Shock-Waves/Turbulent Boundary Layer Interaction ***Final Report, Apr. 1998 - Apr. 1999***
Zheltovodov, Alexander A.; Maksimov, Alexander I.; Jan. 1999; 80p; In English
Contract(s)/Grant(s): F61775-98-WE091
Report No.(s): AD-A363672; EOARD-SPC-98-4037; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report results from a contract tasking Institute of Theoretical and Applied Mechanics as follows: The contractor will help the CFD group at AFRL to better understand shock-wave/turbulent boundary layer phenomena by providing a comprehensive set of experimental data with emphasis on both quantitative and flow visualization aspects. He will fill-in the gaps which exist in the test matrix both at Mach 4 and 5 He will also expand the range of measurements to include shock structure and skin friction coefficient data.
DTIC
Separated Flow; Shock Waves; Hypersonic Shock; Crossings; Hypersonic Flow; Turbulent Boundary Layer

19990054554 University of Electro-Communications, Dept. of Information Mathematics, Tokyo, Japan
Modified Hele-Shaw Moving Boundary Problem Related to some Phase Transition Phenomena
Ohnishi, Isamu, University of Electro-Communications, Japan; Imai, Hitoshi, Tokushima Univ., Japan; Bulletin of the University of Electro-Communications; June 1998; Volume 11, No. 1, pp. 17-28; In English; See also 19990054551; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

We are concerned with the modified Hele-Shaw moving boundary problem and describes the motion of the phase boundary of two phase fluid composed of two kinds of homopolymers (diblock copolymer) near the equilibrium states. We prove the existence of the time local strong solution (the necessary order derivatives of solution in the distribution sense is in the Sobolev space), and investigate the shape of free boundary of equilibrium states.
Author
Boundary Value Problems; Two Phase Flow

19990054647 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Reduction of Large Dynamical Systems by Minimization of Evolution Rate ***Final Report***
Girimaji, Sharath S., Institute for Computer Applications in Science and Engineering, USA; May 1999; 12p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209121; NAS 1.26:209121; ICASE-99-15; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Reduction of a large system of equations to a lower-dimensional system of similar dynamics is investigated. For dynamical systems with disparate timescales, a criterion for determining redundant dimensions and a general reduction method based on the minimization of evolution rate are proposed.
Author
Dynamical Systems; Turbulent Combustion; Reaction Kinetics

19990054650 National Central Univ., Dept. of Mechanical Engineers, Chung-Li Taiwan, Province of China
Velocity Measurements of Sheared Granular Flows
Hsiau, Shu-San, National Central Univ., Taiwan, Province of China; Jang, Hwan-Wha, National Central Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 93-99; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The flow behaviors of granular materials in a shear cell were experimentally studied. Different masses of granular materials were put in an annular shear device with a stationary upper wall and a constantly rotated lower wall. The image processing technique and the particle tracking method were employed to measure average particle velocities and fluctuating velocities in the streamwise and transverse directions. The granular flows consisted of a low shear rate region with higher and more uniform velocities in the lower test section, and a high shear rate region in the upper part. The velocities decreased with the height, while the fluctuations, granular temperature and shear rate increased with the height. The velocity fluctuations were anisotropic and were greater in the streamwise direction. The slip velocity and the low shear layer thickness were greater for the case with greater total granular mass.
Author
Shear Flow; Granular Materials; Shear Layers; Kinetic Theory

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INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see 43 Earth Resources and Remote Sensing. For related information see also 06 Aircraft Instrumentation, and 19 Space Instrumentation.

19990053912 Department of the Navy, Washington, DC USA
Fiber Bragg Grating Interrogation System With Adaptive Calibration
Davis, Michael A., Inventor; Kersey, Alan D., Inventor; Bellemore, David G., Inventor; Oct. 06, 1998; 18p; In English; Supersedes US-Patent-Appl-SN
Patent Info.: Filed 28 Feb. 97,; US-Patent-Appl-SN-810,167; US-Patent-5,818,585
Report No.(s): AD-D019305; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a system and method for providing accurate measurements of the reflected wavelengths from multiple strings of fiber Bragg grating (FBG) elements using a single scanning optical filter and an isolated duplicate reference string of FBG elements. A reference string of FBG elements permits precise long-term wavelength determination of sensors by providing real-time adaptive calibration adjustments to correct for any nonlinearities in the response of the single scanning optical filter. DTIC
Calibrating; Optical Filters; Gratings; Fiber Optics; Bragg Gratings

19990053914 Department of the Navy, Washington, DC USA
Bright Beam Method for Super-Resolution in E-Beam Lithography
Marrian, Christie R., Inventor; Peckerar, Martin C., Inventor; Oct. 20, 1998; 9p; In English; Supersedes US-Patent-Appl-SN-774-063, AD-D019044.
Patent Info.: Filed 23 Dec. 96,; US-Patent-Appl-SN-774,063; US-Patent-5,825,040
Report No.(s): AD-D019303; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a method and apparatus for bonding a layer of coating material onto a substrate with minimal bulk heating of the substrate. A pulsed electron beam generator is used to produce high energy electrons at the beginning of the pulse and a larger number of lower energy electrons at the end of the pulse. A thin sacrificial or ablative layer of an easily vaporized material such as tin is placed on top the coating. The high energy electrons penetrate through the ablative and coating layers. The

ablative layer is heated to a molten state, causing it to vaporize. The ablation process generates a force on the coating layer which drives it into the substrate.
DTIC
Bonding; Coating; High Resolution; Lithography; Electron Beams

19990054156 Department of the Navy, Washington, DC USA
Wavelength Independent Optical Probe
Scheps, Richard, Inventor; Oct. 06, 1998; 4p; In English
Patent Info.: Filed 4 Oct. 96,; US-Patent-Appl-SN-726,238; US-Patent-5,818,601
Report No.(s): AD-D019334; No Copyright; Avail: US Patent and Trademark Office, Microfiche

An optical probe for illuminating a location outside or inside a medical patient with a range of optical wavelengths appropriate to both diagnostic and surgical procedures comprises a polarization-preserving optical waveguide to conduct a polarized light beam to a polarizing beamsplitter, an optical detector to detect light deflected by the beamsplitter, a quarter-wave plate to couple the light between a non-refractive focusing element and a target, and a probe enclosure.
DTIC
Probes; Optical Waveguides; Polarized Light

19990054331 Department of the Navy, Washington, DC USA
System Which uses Porous Silicon for Down Converting Electromagnetic Energy to an Energy Level within the Bandpass of an Electromagnetic Energy Detector
Russell, Stephen D., Inventor; Oct. 27, 1998; 9p; In English
Patent Info.: Filed 6 Mar. 97,; US-Patent-Appl-SN-812,680; US-Patent-5,828,118
Report No.(s): AD-D019292; No Copyright; Avail: US Patent and Trademark Office, Microfiche

An electromagnetic energy detector system down converts electromagnetic energy from a relatively high energy beyond the detectable range of an electromagnetic energy detector to a lower energy level within the detectable range of the electromagnetic energy detector. The detector includes a transparent substrate, a porous silicon structure formed on the substrate for down converting electromagnetic energy characterized by a first wavelength W1 to electromagnetic energy characterized by a second wavelength W2, where W2>W1; and an electromagnetic energy detector for detecting the down converted electromagnetic energy. The detector is useful in applications where the electromagnetic energy detector would ordinarily be incapable of detecting the higher level electromagnetic energy directly without going through the down conversion process effectuated by the porous silicon structure.
DTIC
Down-Converters; Energy Levels; Detection

36
LASERS AND MASERS

Includes parametric amplifiers. For related information see also 76 Solid-State Physics.

19990053698 Naval Research Lab., Beam Physics Branch, Washington, DC USA
Feasibility Experiments for Underwater Shock and Bubble Generation with a High-Power Laser ***Interim Report***
Jones, Theodore G.; Grun, Jacob; Burris, H. R.; Manka, Charles; Apr. 22, 1999; 25p; In English; Prepared in collaboration with ICARUS Research, Inc., Bethesda, MD and Research Support Instruments, Inc., Lanham, MD
Report No.(s): AD-A362880; NRL/MR/6790--99-8317; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

High energy laser pulses (up to 150 joules at 527 nm) were directed onto underwater targets to produce a heated volume which, upon expansion, created underwater shocks and bubbles. These experiments were a feasibility study for a laboratory experimental program studying two phenomena: (1) bubble collapse dynamics in close proximity to a solid interface, and (2) shock propagation dynamics in aerated sand/water mixtures. The laser was focused both onto a point in the water and onto the surface of a solid thin foil target immersed in the water. For both types of targets, the focal volume of the laser beam was in water. Solid laser targets were observed to effectively localize laser energy deposition, providing a point shock source and producing spherical shocks. Shock pressures were inferred from shock propagation speeds to be 30 Kbar at 2 mm, and measured by carbon piezoresistive

gauges to be 200 bar at 13 mm. Bubbles were formed with maximum radii of 15 mm and oscillation times of 3 ms. Key features of a design for a permanent experimental chamber are given in the report.
DTIC
Thermal Shock; Feasibility Analysis; Water; Underwater Explosions; Mechanical Shock; Bubbles

19990053700 Schafer Corp., Arlington, VA USA
APEX Support
Feb. 1999; 9p; In English
Contract(s)/Grant(s): N00014-97-D-2014
Report No.(s): AD-A361665; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Under the APEX program, Schafer Corporation has been supporting both the Ballistic Missile Defense Organization and the Naval Research Laboratory (NRL) in investigating the potential of using nonlinear optical techniques as well as other advanced technologies to improve the performance and/or the system integration and operation of CW high energy lasers, specifically the HF/DF chemical laser. The goal of the APEX program is to provide a CW demonstration of beam clean up using Stimulated Brillouin Scattering (SBS) phase conjugation and to assess its application to the Space Based Laser (SBL) program. Under the present activity, Schafer Corporation reviewed the status and progress of the activities under the APEX program and performed assessments as to the adequacy and the appropriateness of the APEX program to provide a realistic system impact for the HF/DF chemical laser systems of interest to NRL and BMDO. Specifically, we assessed the status of the SBS cell, the NACL(NAVY/ARPA Chemical Laser) laser, and the connecting optical train to perform a meaningful demonstration and to assess its impact on system performance.
DTIC
Antimissile Defense; Nonlinear Optics; Chemical Lasers; Continuous Wave Lasers; Ballistic Missiles; Hf Lasers

19990053702 Schafer Corp., Albuquerque, NM USA
ABL Illuminator
Feb. 1999; 45p; In English
Contract(s)/Grant(s): N00014-97-D-2014
Report No.(s): AD-A361738; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Schafer's effort in support of the COIL Illuminator consisted of the following task areas: 1. Development of gas laser vision statement; 2. Coordination of contractor and university Raman efforts; 3. Raman analysis; 4. ABL SPO illuminator interface activity; 5. Preparation of briefing comparing gas and solid state laser scaling characteristics; and 6. COIL CFD workshop support.
DTIC
Antimissile Defense; Solid State Lasers; Gas Lasers

19990053704 Schafer Corp., Arlington, VA USA
Space Based Laser Support
Feb. 1999; 509p; In English
Contract(s)/Grant(s): N00014-97-D-2014
Report No.(s): AD-A361742; No Copyright; Avail: CASI; A22, Hardcopy; A04, Microfiche

This report summarizes efforts in support of the BMDO/AFSMC Space Based Laser program. The first major work section was in support of BMDO. Another series of major efforts supported AF SMC. These efforts were broad in nature and reflect changing priorities during the report period. Section titles reflect the majority of work performed, but there is overlap among sections The final major section was in support of the NSWC ABCS program, within the BMDO SBL technology base. Schafer was supported by subcontractors, including Photon Research Associates (PRA) and the University of Illinois Urbana-Champagne (UtUC).' Subcontractor reports will be referred to appropriately in the body of the main report, but will be included in their entirety as Appendices. Some of the work reported is classified and will be contained in a separate classified Appendix. A small proprietary Appendix is also included under separate cover. Finally, some of the efforts were competition sensitive to either of the contractor teams during the SBL Concept Definition Studies (CDS). Due to the restrictions imposed by the competition, these efforts are reported only in summary.
DTIC
Antimissile Defense; Laser Weapons; Space Weapons

19990053823 Communications Research Lab., Tokyo, Japan

Generation of Coherent Light and its Application to Laser Cooling and Control of Atoms and Ions

Watanabe, Masayoshi, Communications Research Lab., Japan; Ohmukai, Ryuzo, Communications Research Lab., Japan; Tanaka, Utako, Communications Research Lab., Japan; Hayasaka, Kazuhiro, Communications Research Lab., Japan; Imajo, Hidetsuka, Communications Research Lab., Japan; Matsubara, Kensuke, Communications Research Lab., Japan; Urabe, Shinji, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 599-610; In Japanese; See also 19990053822; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Recent progress in laser technology opens up a new research field based on the laser-cooling and manipulation of atoms (or ions). It has brought innovations to fundamental research areas and also stimulated the technical development based on handling of atoms by light force. The laser physics section has been carrying out various experiments on advanced laser technology and its applications for these ten years. Here we will review specific research topics which include the followings: generation of coherent light in the short wavelength region, laser-cooling of trapped ions, and control of atomic beam by light force.

Author

Coherent Light; Laser Cooling; Heat Generation

19990053824 Communications Research Lab., Tokyo, Japan

Research on Advanced Technologies for Controlling Lasers

Onodera, Noriaki, Communications Research Lab., Japan; Ishizu, Mitsuo, Communications Research Lab., Japan; Kasai, Katsuyuki, Communications Research Lab., Japan; Zhou, Jun, Communications Research Lab., Japan; Hyodo, Masaharu, Communications Research Lab., Japan; Tani, Masahiko, Communications Research Lab., Japan; Abedin, Kazi Sarwar, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 611-624; In Japanese; See also 19990053822; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

In this paper, the technologies developed in the lightwave technology section in Kansai Advanced Research Center, established in 1989, have been reviewed and some of the results are described. Research on squeezed light is undergoing since 1989 where squeezed states for vacuum and bright light have been successfully generated, During the year 1993 and 1994, research on the stabilization of laser diode pumped Nd: YVO4 lasers was performed and oscillation with linewidth as small as l mHz was obtained. In a recent research project, dedicated to the short pulse generation from fiber and semiconductor lasers, amplitude modulated signal with repetition rates up to 40.6 THz has been realized, and novel methods for stabilizing the fiber lasers have been developed. These technologies will play important roles for future applications in the fields of communications, solid-state physics, and various measurement systems requiring ultra high accuracy and resolutions.

Author

Fiber Lasers; Research; Technology Assessment; Squeezed States (Quantum Theory)

19990053892 Department of the Navy, Washington, DC USA

Type II Quantum Well Laser with Enhanced Optical Matrix

Meyer, Jerry R., Inventor; Hoffman, Craig A., Inventor; Bartoli, Filbert J., Inventor; Aug. 11, 1998; 20p; In English; Supersedes US-Patent-Appl-SN-585612, AD-D018221

Patent Info.: Filed 16 Jan. 96,; US-Patent-Appl-SN-585,612; US-Patent-5,793,787

Report No.(s): AD-D019307; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a type II multiple quantum well, 4 constituent active region, optically clad electrically pumped and optically pumped laser for emitting at a wavelength greater than or equal to about 2.5 microns is disclosed. The active region comprises one or more periods, each period further comprising a barrier layer, a first conduction band layer, a valence band layer and a second conduction band layer.

DTIC

Semiconductor Lasers; Quantum Well Lasers; Quantum Wells; Barrier Layers

19990053916 Massachusetts Univ., Boston, MA USA

Modeling of Silicon Quantum Structures ***Final Report, Aug. 1997 - Aug. 1998***

Sun, Gregory; Apr. 1999; 24p; In English

Contract(s)/Grant(s): F30602-97-2-0151; AF Proj. 2305

Report No.(s): AD-A363362; AFRL-SN-RS-TR-1999-65; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The proposed research was to investigate the carrier optical-phonon interaction in a mixed polar-nonpolar material system of Si/ZnS superlattices, where not only carriers are confined, but also the optical phonons. The heavy-hole subbands and associ-

ated wave functions were calculated for Si/ZnS superlattices. Optical phonon confinement were modeled successfully using a continuum model with proper mechanical and electrostatic boundary conditions satisfied at the heterointerface. The established model for the confined optical phonons is used in calculating the intersubband heavy-hole scattering rate by optical phonons in the Si/ZnS superlattice. This work establishes the theoretical foundation to determine subband lifetimes in the design of Si/ZnS quantum well intersubband lasers.
DTIC
Quantum Wells; Semiconductor Lasers; Quantum Well Lasers; Boundary Conditions; Electrostatics; Wave Functions

19990054052 GIA Research, Carlsbad, CA USA
Microgravity Tested 38 W CO2 Laser Reactor Prototype for the Gas-Phase Synthesis of Refractory Materials
Buerki, P. R., GIA Research, USA; Ott, U., Max-Planck-Inst. fuer Chemie, Germany; Roth, P., Duisburg Univ., Germany; Fifth International Microgravity Combustion Workshop; May 1999, pp. 377-380; In English; See also 19990053965; Sponsored in part by the Swiss government
Contract(s)/Grant(s): BMBF Proj. 50WM9584; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The use of CO2 laser driven flow reactors for the gas-phase synthesis of high purity ceramic powders, including Si3N4, SiC, B4C, TiO2, TiB2, and diamond, has become an established method during the past twenty years. by matching an emission line of the CO2 laser with a strong absorption band of at least one of the reactants, an efficient and rapid excitation and the initiation of chemical reactions is achieved. A wall-free compartment is created at the intersection of laser beam and reactant gas flow. Typical for laser driven gas-phase reactions are high temperature gradients (106 K/m), fast heating (10(exp 5) K/s) and fast cooling rates (10(exp 4) K/s), which cause strong gravity induced convection on ground. Consequently, the particle growth and particle properties depend strongly on the local conditions in the reaction zone. This results in broad and often multimodal particle size distributions, hard agglomerates, and large variations of particle characteristics within the same batch. Until recently, the use of high power lasers in microgravity research had been rather limited, due to severe restrictions in terms of safety, weight, power consumption and cooling requirements. With the development of more compact and energy efficient CO2 lasers and multiwatt laser diodes, laser induced gas-phase materials synthesis is now ready to be applied in microgravity research. Compared to crystal growth from the melt or from solution, microgravity experiments on gas-phase materials synthesis are still rare and suitable hardware is not widely available. The characteristics and performance of a first prototype of a CO2 laser driven reactor for gas-phase materials synthesis and attempts to synthesize diamond particles in microgravity are the topic of the present report. Instead of using a flow reactor, the syntheses were performed in batches, i.e., the laser photolysis of reactant gas bubbles created in the center of a reaction chamber filled with nitrogen. The experiments were performed during the 25th ESA Parabolic Flight Campaign, October 20-30, 1998 in Bordeaux-Merignac (France).
Derived from text
Carbon Dioxide Lasers; Refractory Materials; Synthesis (Chemistry); Laser Applications; Microgravity; Ceramics; Powder (Particles)

19990054056 Texas Univ., Center for Aeromechanics Research, Austin, TX USA
Diode Laser Velocity Measurements by Modulated Filtered Rayleigh Scattering
Mach, J. J., Texas Univ., USA; Varghese, P. L., Texas Univ., USA; Jagodzinski, J. J., Texas Univ., USA; Fifth International Microgravity Combustion Workshop; May 1999, pp. 393-396; In English; See also 19990053965
Contract(s)/Grant(s): TATP-003658-454; NSF CTS-98-71249; NRA-97-HEDS-01; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The ability of solid-state lasers to be tuned in operating frequency at MHz rates by input current modulation, while maintaining a relatively narrow line-width, has made them useful for spectroscopic measurements. Their other advantages include low cost, reliability, durability, compact size, and modest power requirements, making them a good choice for a laser source in microgravity experiments in drop-towers and in flight. For their size, they are also very bright. In a filtered Rayleigh scattering (FRS) experiment, a diode laser can be used to scan across an atomic or molecular absorption line, generating large changes in transmission at the resonances for very small changes in frequency. The hyperfine structure components of atomic lines of alkali metal vapors are closely spaced and very strong, which makes such atomic filters excellent candidates for sensitive Doppler shift detection and therefore for high-resolution velocimetry. In the work we describe here we use a Rubidium vapor filter, and work with the strong D(sub 2) transitions at 780 nm that are conveniently accessed by near infrared diode lasers. The low power output of infrared laser diodes is their primary drawback relative to other laser systems commonly used for velocimetry. However, the capability to modulate the laser frequency rapidly and continuously helps mitigate this. Using modulation spectroscopy and a heterodyne detection scheme with a lock-in amplifier, one can extract sub-microvolt signals occurring at a specific frequency from a

background that is orders of magnitude stronger. The diode laser modulation is simply achieved by adding a small current modulation to the laser bias current. It may also be swept repetitively in wavelength using an additional lower frequency current ramp. Derived from text

Velocity Measurement; Rayleigh Scattering; Semiconductor Lasers; Laser Spectroscopy; Laser Doppler Velocimeters; Semiconductor Diodes

19990054171 Department of the Navy, Washington, DC USA

Apparatus and Method for Coherent Acousto-Optic Signal Width Modification

Alexander, Edward M., Inventor; Lee, John N., Inventor; Spezio, Anthony E., Inventor; Oct. 13, 1998; 6p; In English; Supersedes US-Patent-Appl-SN-492270, AD-D018157.

Patent Info.: Filed 3 May 95,; US-Patent-5,822,111; US-Patent-Appl-SN-492,270

Report No.(s): AD-D019320; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a apparatus and method for coherently stretching or compressing signals of interest, i.e., without loss of information. A first, or tapping, Bragg cell has an acoustic signal launched in it which is modulated onto a laser carrier. The signal of interest is launched into a second, or signal, Bragg cell, and is similarly modulated onto the carrier exiting the first Bragg cell. Upon demodulation, the resultant signal, is the convolution of the two acoustic signals in the respective Bragg cells, but whose duration is either stretched or compressed according to the relative velocity between the acoustic signals in the two Bragg cells, and by the magnification of optics between the two cells. If the signal in the first Bragg cell is of such a short duration that it is effectively an impulse, the resultant signal is a coherently stretched or compressed replica of the signal launched into the second Bragg cell, i.e., the signal of interest.

DTIC

Acousto-Optics; Bragg Angle; Bragg Cells; Demodulation; Sound Waves

19990054174 Department of the Navy, Washington, DC USA

Modulator Lidar System

Contarino, Vincent M., Inventor; Herczfeld, Peter R., Inventor; Mullen, LInda J., Inventor; Oct. 13, 1998; 17p; In English; Supersedes US-Patent-Appl-SN

Patent Info.: Filed 29 Aug. 95,; US-Patent-Appl-SN-521,083; US-Patent-5,822,047

Report No.(s): AD-D019332; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a A modulated LIDAR system is disclosed, in which a laser for generating an optical carrier signal and a microwave generator for generating a coded microwave signal are provided. A modulator is further provided for modulating the carrier signal with the microwave signal, whereby a modulated signal is generated. A method of detecting a reflective surface is also disclosed, in which an optical carrier signal is generated, the carrier signal is modulated with a coded microwave signal, the modulated signal is reflected off of a reflective surface and the reflected signal is recovered.

DTIC

Optical Radar; Infrared Lasers; Signal Generators; Microwaves; Modulators

19990054346 Lawrence Livermore National Lab., Livermore, CA USA

Nd(3+) and Yb(3+) doped phosphate glass waveguides fabricated using electric field assisted Ag(+) diffusion

Patel, F. D.; Honea, E. C.; Krol, D.; Payne, S. A.; Hayden, J. S.; Dec. 17, 1997; 9p; In English; Topical meeting on advanced solid-state lasers and radiative processes and dephasing in semiconductors topical meeting

Report No.(s): DE98-052068; UCRL-JC-128817; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Solid-state waveguide lasers offer several attractive features that may make high efficiency and effective thermal management possible. Due to the ability to confine pump light to high intensity over distances much longer than the Rayleigh range, as well as maintaining good overlap between the pump and Iasing modes over the entire guiding region, efficient operation with high slope efficiency should be possible, even for quasi-three level laser systems. Since the waveguide region is typically only a few microns of thickness, heat can be extracted efficiently from the structure. The effects of heating are of less significance than in bulk solid-state lasers because mode confinement is maintained by an index of refraction difference, usually much larger than that induced by dn/dT or stress-optic effects. Rare earth doped waveguide laser action has been reported in numerous papers. The processes for fabricating waveguides include film deposition methods such as epitaxial growth, RF sputtering, and most recently, thermal bonding of precision finished crystals. In addition, ion implantation, ion exchange in a molten salt and electric field assisted solid film diffusion have been utilized. The ion exchange method remains the simplest, particularly for many common laser glasses that already have mobile ions, and has received considerable attention in recent years. An excellent review is found in reference. Our work has focused on developing process conditions for the fabrication of waveguides in phosphate laser glasses

using solid silver film diffusion. These processes are important in determining the overall structure and properties of the guiding region, such as propagation loss, modal profile, and modal overlap between the pump and laser wavelengths. Phosphate laser glass was chosen as the solid state laser medium due to the useful spectroscopic properties of rare earth ions in these materials, as well as the range of material properties and compositions possible.
NTIS
Phosphates; Neodymium; Ytterbium; Fabrication; Doped Crystals; Waveguides; Silver; Ion Implantation; Ions; Metal Films; Metal Ions

37
MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

19990053512 New South Wales Univ., School of Mechanical and Manufacturing Engineering, Sydney, Australia
Detection of Bearing Faults in Helicopter Gearboxes
Gao, Yujin, New South Wales Univ., Australia; Randall, R. B., New South Wales Univ., Australia; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 99-111; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Contents include the following: (1) Special analysis: requirement of baseline spectra and sideband growth and spectrum level increase. (2) Cepstral analysis: periodic structures in log spectra and better than Kurtosis. (3) Statistical parameters: applied to band pass filtered envelope signals and may produce confusing indication. (4) Envelope analysis: digital implementation; flexibility in choosing passbands; harmonic family and sidebands and combination with SANC. (5) CPB spectral analysis: wide frequency range with limited samples; comparison with mask; and stable detection information. (6) neural network: CPB spectrum analysis is a valid data preprocessor; good success rate with helicopter gearbox bearing faults (based on limited data) and the bearing fault in the gearbox test rig; too expensive to experience all the faults we would like to diagnose; and mathematical model and digital simulation.
CASI
Fault Detection; Helicopters; Spectrum Analysis; Sidebands; Mathematical Models; Bearings; Transmissions (Machine Elements)

19990053513 Naval Research Lab., Washington, DC USA
LASERNET Machinery Monitoring Technology
Reintjes, John, Naval Research Lab., USA; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 113-130; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

New technology should provide information as to: is there a fault in the equipment, if so, what type of fault is it and how bad is it; Provide complementary information for data fusion with other sensors: same type of fault identification information; independent corroboration; Have ability to provide input for prognostic models.
CASI
Technology Assessment; Fault Detection

19990053642 Massachusetts Inst. of Tech., Gas Turbine Lab., Cambridge, MA USA
Aerodynamic Response of Turbomachinery Blade Rows to Convecting Density Wakes ***Final Report, 1 Oct. 1994 - 31 Dec. 1998***
Tan, Choon S.; Covert, Eugene E.; Wilson, T.; Ramer, B.; Wijesinghe, H. S.; Jan. 03, 1999; 110p; In English
Contract(s)/Grant(s): F49620-98-1-0272
Report No.(s): AD-A363039; AFRL-SR-BL-TR-99-0121; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The aim of the current research has been to contribute to the ”aerodynamic forcing function” aspect of the high cycle fatigue problem. In this regard density wakes were identified as a potential new source of turbomachinery blade vibration. In order to characterize the density wake induced force and moment fluctuations a two-dimensional computational study was conducted to simulate the passage of density wakes through a cascade blade row. Both inviscid incompressible flows and viscous compressible flows M sub infinity=0.15 to M sub infinity=0.87 and Reynolds number Re(c,U sub infinity) approximately equal 700,000) were considered. The inviscid flow simulations show a pair of counterrotating vortices in the blade passage and a flux of density wake

fluid to the blade suction/pressure surface as low/high density wakes convect through the blade row. This fluid flux is found to be the key mechanism which affects the blade static pressure distribution and hence the blade force and moment response. The viscous flow simulations have uncovered additional mechanisms for blade force and moment fluctuations: (1) periodic vortex shedding at the blade trailing edge, (2) convecting separation bubbles on the blade suction surface (due to the density wake - blade boundary layer interaction) and (3) axial deflection of the blade passage shock wave position (due to the density wake - shock wave interaction). Simple functional relationships have been derived to quantify the force and moment fluctuations for each flow simulation. A simple cascade flow model has also been developed to determine parametric trends in the blade force and moment fluctuations with varying density wake properties and compressor geometries.
DTIC
Turbomachinery; Wakes; Convection; Cascade Flow; Rotor Blades (Turbomachinery)

19990053853 Oesterreichische Raumfahrt- und Systemtechnik, Vienna, Austria
The XMM Deployment Mechanisms: Mirror Doors and Telescope Sun Shield
Nitschko, T., Oesterreichische Raumfahrt- und Systemtechnik, Austria; Falkner, M., Oesterreichische Raumfahrt- und Systemtechnik, Austria; Zemann, J.-V., Oesterreichische Raumfahrt- und Systemtechnik, Austria; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 1-14; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents the development of the deployment & hold-down mechanisms of the Telescope Sun Shield (TSS) and the Mirror & Optical Monitor Doors (MOD) for the X-ray Multi Mirror (XMM) satellite. The XMM mission of the European Space Agency (ESA) is dedicated to the study of the X-ray portion of the electromagnetic spectrum. The scope of the paper includes the presentation of design and performance as well as a discussion of the test results and lessons learned from this demanding development.
Author
X Ray Telescopes; Deployment; Spacecraft Modules; Service Modules; Doors; Mechanical Devices; Mechanization

19990053854 Able Engineering Co., Inc., Goleta, CA USA
The Able Deployable Articulated Mast: Enabling Technology for the Shuttle Radar Topography Mission
Gross, Dave, Able Engineering Co., Inc., USA; Messner, Dave, Able Engineering Co., Inc., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 15-30; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

An ABLE Deployable Articulated Mast (ADAM) was developed that deploys an antenna 60m from the Orbiter to achieve the desired three-dimensional mapping resolution required for the Shuttle Radar Topography Mission (SRTM). The ADAM deploys to 44 times its stowed length with is less than 1 mm precision and is designed to maintain its position within a few millimeters under Orbiter attitude control forces and the orbital environment. The thermo-mechanical and structural characteristics of the ADAM are described herein.
Author
Self Erecting Devices; Space Erectable Structures; Spacecraft Structures; Beams (Supports); Structural Design; Deployment; Mechanization; Mechanical Devices

19990053856 NASA Goddard Space Flight Center, Greenbelt, MD USA
A Flight Prediction for Performance of the SWAS Solar Array Deployment Mechanism
Sneiderman, Gary, NASA Goddard Space Flight Center, USA; Daniel, Walter K., Mechanical Dynamics, Inc., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 43-56; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The focus of this paper is a comparison of ground-based solar array deployment tests with the on-orbit deployment. The discussion includes a summary of the mechanisms involved and the correlation of a dynamics model with ground based test results. Some of the unique characteristics of the mechanisms are explained through the analysis of force and angle data acquired from the test deployments. The correlated dynamics model is then used to predict the performance of the system in its flight application.
Author
Performance Prediction; Dynamic Models; Solar Arrays; Ground Tests; Deployment

19990053857 Able Engineering Co., Inc., Goleta, CA USA
250 Meter Wire Antenna Deployer Mechanism
Allen, Scotty R., Able Engineering Co., Inc., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 57-72; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

A wire antenna deployer for the Radio Plasma Imager (RPI) instrument on the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) spacecraft has been developed and qualified for space flight by AEC-Able Engineering Company, Incorporated. Performance specifications; design of the deployer mechanism; and lessons learned during the design, manufacturing and testing phases of the program are presented. Unique aspects of this design include a mechanism capable of withstanding sustained high voltages in excess of 6400 VAC, an internal wire tensioning device, and use of stepper motors to provide simultaneous antenna deployment in the spin plane of the spacecraft of 4 deployers at virtually identical rates.
Author
Functional Design Specifications; Spacecraft Structures; Mechanical Devices; Mechanization; Stepping Motors; Controllers

19990053859 Starsys Research Corp., Boulder, CO USA
Reduced Gravity Testing in NASA's KC-135A Aircraft: A Case Study of the Space Infrared Telescope Facility Ejectable Dust Cover
Huettl, Brett, Starsys Research Corp., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 85-100; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Dust Cover on the Space Infrared Telescope Facility (SIRTF) protects the instrument during launch, and then deploys on orbit exposing the telescope. During deployment the cover hinge mechanism ejects the cover allowing it to separate from the spacecraft. The necessity to observe and understand the actual motion of the cover during and after ejection required testing the mechanism on NASA's KC-135A reduced gravity aircraft. This paper discusses unusual aspects of the ejectable hinge design, rationale for choosing this method of testing, information on preparation for and completing reduced gravity testing, and the results and lessons learned.
Author
Microgravity; Hinges; Spacecraft Structures; Structural Design; Mechanical Devices; Latches; Protection; Flight Tests

19990053860 Lockheed Martin Astronautics, Denver, CO USA
Development of the Mars Polar Lander Retention and Release Mechanism
Rudolph, Dale, Lockheed Martin Astronautics, USA; Mathews, Scott, Lockheed Martin Astronautics, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 101-114; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

MARS'98 is the latest NASA program aimed at learning more about the 'Red Planet'. It is preceded by the similar missions of Viking in 1976, and more recently, Pathfinder and Mars Global Surveyor (MGS) in 1996. The MARS'98 mission includes two spacecraft, the Mars Climate Orbiter, which launched in December of 1998, and the Mars Polar Lander (MPL), which launched in January of 1999. The Lander will enter the Martian atmosphere enclosed in a protective aeroshell (comprising a backshell and heatshield), and unlike Pathfinder, will fly a controlled descent to the planet's surface using rocket engines once it has separated from the backshell. The precisely sequenced operation of the MPL Retention and Release (R&R) mechanism is essential to the successful separation of the Lander from the backshell, and the non-operation of any of the four R&R mechanisms comprising the separation system represents a single point failure that would end the spacecraft mission. Also, as a structural load path, all four R&R mechanisms must share Lander support loads in unison, and the failure of any one would result in catastrophic structural failure of the vehicle. This paper focuses on the design, development, and testing of the MPL R&R mechanisms and related separation systems, and lessons learned throughout this process.
Author
Mars Polar Lander; Spacecraft Structures; Deployment; Mechanical Devices; Spacecraft Configurations; Structural Design

19990053861 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Mobility Sub-System for the Exploration Technology Rover
Lindemann, Randel, Jet Propulsion Lab., California Inst. of Tech., USA; Reid, Lisa, Jet Propulsion Lab., California Inst. of Tech., USA; Voorhees, Chris, Jet Propulsion Lab., California Inst. of Tech., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 115-130; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

A new six-wheeled robotic roving vehicle was developed for NASA's Exploration Technology (ET) program. The rover which is called the Field, Integrated, Design, and Operations (FIDO) rover is being used for advanced technology development. In addition, copies of FIDO's Mobility Sub-System (MSS) are being used for software development in several NASA projects, including the prototype for the flight Athena Rover of the Mars Sample Return (MSR) 2003 mission. The focus of this paper is

the work done on the MSS, specifically the development and test of the wheel drive actuators, which are fundamental to vehicle mobility.
Author
Actuators; Mechanical Drives; Robotics; Roving Vehicles; Structural Design

19990053862 ITT Industries, Inc., Aerospace/Communications Div., Fort Wayne, IN USA
Application of Magnetic Ball Bearings to Precision Mechanism Concepts
Joffe, Benjamin, ITT Industries, Inc., USA; Hookman, Robert A., ITT Industries, Inc., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 131-136; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

An overview of the design application of magnetic ball bearings to precision mechanism concepts is presented. The magnetic ball bearings are used in precision mechanisms that require zero backlash. Magnetic forces hold the bearings together and provide a controlled preload on the bearings. Design guidelines for the magnetic ball bearings are outlined and discussed. Several design concepts are introduced along with a discussion of the advantages gained with the magnetic ball bearing approach. The magnetic ball bearings permit extremely compact designs to be implemented with a minimum number of components. Many design configurations that combine precision motion, minimum mass and compact size are possible. These attributes make the use of magnetic ball bearings attractive for many space mechanism applications.
Author
Magnetic Bearings; Ball Bearings; Mechanical Devices; Design Analysis

19990053863 NASA Lewis Research Center, Cleveland, OH USA
Cartridge Bearing System for Space Applications
Kingsbury, Edward P., Bearing Consultants, LLP, USA; Hanson, Robert A., MPB Corp., USA; Jones, William R., NASA Lewis Research Center, USA; Mohr, Terry W., Timken Co., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 137-143; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

Conventional spin axis ball bearings have been unreliable in spacecraft, often failing by two heretofore uncontrolled processes: ball retainer instability and lubricant breakdown. The Space Cartridge Bearing System (SCBS) addresses each of these mechanisms directly, leading to a bearing system with absolute freedom from retainer instability and negligible lubricant degradation rate. The result is a reliable plug-in bearing cartridge with a definite design life.
Author
Ball Bearings; Technology Utilization; Mechanical Devices; Life (Durability)

19990053864 Axsys Technologies, Inc., San Diego, CA USA
Optical Scanner Utilizing Brushless DC Motor
Dufel, Ronald, Axsys Technologies, Inc., USA; Withall, Ian, Axsys Technologies, Inc., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 145-149; In English; See also 19990053852; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

The Motion Control Division of Axsys Technologies was contracted by ITT Aerospace to design and build a new Optical Scanner/Control Electronics to be used in their Advanced Very High Resolution Radiometer. This scanner is used to rotate a mirror, which scans the earth's atmosphere and surface at an extremely precise rotational speed. This paper describes the mechanical systems employed.
Author
Mechanical Devices; Electric Motors; Functional Design Specifications; Design Analysis; Optical Scanners; Direct Current

19990053866 Boeing Co., Seattle, WA USA
Powered Bolt and Nut Assemblies: International Space Station
Alexander, Erik, III, Boeing Co., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 157-162; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

The Powered Bolt and Nut Assemblies are the key mechanisms used in the assembly of the International Space Station. Their innovative designs have resulted in the elimination of crossthreading during thread engagement and established accurate load measurement while providing robust lubricant performance and high galling resistance. Furthermore, valuable insights were discovered in regard to producing large quantities of space hardware.
Author
International Space Station; Orbital Assembly; Threads; Nuts (Fasteners); Mechanical Devices

19990053867 Alenia Spazio S.p.A., Space Div., Rome, Italy

The Development of a Foldable, High Stiffness, High Strength Holddown and Release Mechanism System

Meschini, Alberto, Alenia Spazio S.p.A., Italy; Scardecchia, Ettore, Alenia Spazio S.p.A., Italy; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 163-168; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

A new deployable Holddown and Release Mechanism (HRM) system to firmly restrain an antenna during launch and to release it once in orbit has been developed, qualified and flown. The system consists of three HRM units that provide an almost isostatic launch restraint since each HRM unit is able to block two rigid body degrees of freedom. The HRM has been deeply investigated by analysis to predict structural and functional performance. After an extensive qualification program, the system has been successfully operated aboard European telecommunication satellites.

Author

Mechanical Devices; Satellite Antennas; Releasing; Antenna Components; Folding Structures; Separation

19990053868 DaimlerChrysler Aerospace A.G., Research and Technology Center, Munich, Germany

Shape Memory Based Release Mechanism for Satellite Devices

Voggenreiter, H., DaimlerChrysler Aerospace A.G., Germany; Schuster, A., DaimlerChrysler Aerospace A.G., Germany; Mertmann, M., Memory-Metalle G.m.b.H., Germany; Reindl, M., KRP Kielkopf and Reindl, Germany; Roth, M., DaimlerChrysler Aerospace A.G., Germany; Vorbrugg, H., Dornier Luftfahrt G.m.b.H., Germany; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 169-174; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

In aerospace vehicles, solar panels have to be fixed during launch, and they finally have to be released and unfolded in orbit. Melting wires or pyrotechnic devices are used for these holddown and release mechanisms. Due to remarkable drawbacks of these conventional release mechanisms, alternative solutions by simpler and more reliable Shape Memory Actuators are in development.

Author

Spacecraft Structures; Folding Structures; Actuators; Shape Memory Alloys; Solar Cells; Deployment; Smart Materials

19990053869 MPB Corp., Keene, NH USA

A Measurement of Torque and Self-Generated Temperature Changes, Comparing Hybrid Bearings to All Steel Ball Bearings

Ward, Peter C., MPB Corp., USA; Leveille, Alan, Leveille (Alan) and Associates, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 175-179; In English; See also 19990053852; No Copyright; Avail: CASI; A01, Hardcopy; A04, Microfiche

This experiment measured the torque and stress-induced temperature changes of Reaction Wheel Assembly and Control Moment Gyro quality ball bearing pairs while varying speed and initial preload. This work explores the analytical model that predicts ceramic hybrid, preloaded pairs run cooler and with lower torque, allowing much higher speeds without lubrication damage. The test results bear out the ball bearing analytical model. Data show torque and temperature comparisons are not significantly different from prediction. Lessons learned on how to design bearings for momentum devices and other mechanisms are discussed.

Author

Ball Bearings; Torque; Temperature Gradients; Mathematical Models; Hybrid Composites; Damage Assessment

19990053870 American Technology Consortium, Oxnard, CA USA

SRTM Substitute Motor Drive Assembly

Petercsak, Doug, American Technology Consortium, USA; Sprunck, Jim, American Technology Consortium, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 181-186; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

Shuttle Radar Topography Mapper (SRTM) is a joint 11-day shuttle mission (STS-99, Atlantis) of NASA, the U.S. Department of Defense National Imagery and Mapping Agency, DLR, and ASI, the Italian Space Agency, scheduled for September 1999. Two independent SAR systems, one in C-band (NASA JPL instrument) the other in X-band (DLR/ASI), will operate with the main antenna of each instrument located in the open cargo bay of the shuttle, with a second receive antenna mounted on a deployable outboard mast. SRTM represents the first use of fixed baseline single-pass spaceborne IFSAR technology with wide-swath scanning SAR and dual frequency. The deployable mast extends to 70 m (200 ft) and will be the largest deployable structure ever flown. Deployment of the large mast required the development of a 500 W (0.6 hp) actuator with integral electronics. Although the actuator is complex both mechanically and electrically, it is most notable for its tight integration of mechanism and electronics. The tight electromechanical integration resulted in a 30% reduction in actuator weight when compared with competitive designs. The weight reduction was achieved in spite of the addition of many new features not found on other units. Close electronic and mechan-

ical integration was achieved through in-house development in both disciplines. As with any development program difficulties along the way led to new insights that will become invaluable when applied to future programs.
Author
Shuttle Imaging Radar; Design Analysis; Equipment Specifications; Electric Motors; Topography

19990053872 NASA Langley Research Center, Hampton, VA USA
The Clouds and the Earth's Radiant Energy System Elevation Bearing Assembly Life Test
Brown, Phillip L., NASA Langley Research Center, USA; Miller, James B., NASA Langley Research Center, USA; Jones, William R., Jr., NASA Lewis Research Center, USA; Rasmussen, Kent, TRW Space Technology Labs., USA; Wheeler, Donald R., NASA Lewis Research Center, USA; Rana, Mauro, NYMA, Inc., USA; Peri, Frank, NASA Langley Research Center, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 197-212; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Clouds and the Earth's Radiant Energy System (CERES) elevation scan bearings lubricated with Pennzane SHF X2000 and 2% lead naphthenate (PbNp) were life tested for a seven-year equivalent Low Earth Orbit (LEO) operation. The bearing life assembly was tested continuously at an accelerated and normal rate using the scanning patterns developed for the CERES Earth Observing System AM-1 mission. A post-life-test analysis was performed on the collected data, bearing wear, and lubricant behavior.
Author
Earth Observing System (EOS); Satellite-Borne Instruments; Scanners; Radiometers; Bearings; Accelerated Life Tests; Life (Durability); Performance Tests

19990053874 Officine Galileo S.p.A., Florence, Italy
Life Test Development and Results for the GERB Mirror De-Spinning Mechanism
Fabbrizzi, Fabio, Officine Galileo S.p.A., Italy; Sawyer, Eric, Rutherford Appleton Lab., UK; Gill, Steve, AEA Technology, UK; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 221-235; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The De-Spinning Mechanism (DSM) for the Geostationary Earth Radiation Budget instrument (GERB) utilizes continuously rotating dry lubricated bearings rotating at a speed of 50 rpm under a 16 g constant centrifugal acceleration. A series of horizontal axis bearing tests under 1 g was first performed on six lubricant options in order to select the three best to be subsequently tested on a specially built centrifuge. In the centrifuge test, all three chosen options failed before reaching the required equivalent 3.5-year operational life in revolutions. The wear debris caused the bearings to jam, as insufficient room was available for debris to escape. Nevertheless, all the lubricants and the bearing parts were still in very good condition at test conclusion.
Author
Satellite-Borne Instruments; Bearings; Mechanical Devices; Lubricants; Rotation; Service Life; Performance Tests; Failure Analysis; Lubrication

19990053875 NASA Glenn Research Center, Cleveland, OH USA
The Effect of Stress and TiC Coated Balls on Lubricant Lifetimes Using a Vacuum Ball-on-Plate Rolling Contact Tribometer
Jones, William R., Jr., NASA Glenn Research Center, USA; Jansen, Mark J., AYT Corp., USA; Helmick, Larry H., Cedarville Coll., USA; Nguyen, QuynhGiao, AYT Corp., USA; Wheeler, Donald R., NASA Glenn Research Center, USA; Boving, Hans J., Centre Suisse d'Electronique et de Microtechnique S..A., Switzerland; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 237-245; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

A vacuum ball-on-plate rolling contact tribometer was used to determine the relative lifetimes of a perfluoropolyether (Krytox 143 AC) on 440C stainless steel. The effect of mean Hertzian stresses (0.75, 1.0, 1.5, and 2.0 GPa) and the use of TiC-coated balls on lubricant lifetime was studied. Other conditions included: 100 rpm, 50 micro-g of lubricant, an initial vacuum level of less than 1.0 x 10(exp -8) Torr, and room temperature (23 C). Increasing the mean Hertzian stress from 0.75 to 2.0 GPa results in an exponential decrease in lubricant lifetime for both material combinations. However, substituting a TiC ball for the 440C ball quadrupled lifetime at low stress levels (0.75 and 1.0 GPa) and doubled life at higher stresses (1.5 and 2.0 GPa). The reduced reactivity of the TiC surface with the PFPE lubricant is considered to be the reason for this enhancement. Decreasing lifetime with increasing stress levels correlated well with energy dissipation calculations.
Author
Stainless Steels; Coatings; Lubricants; Life (Durability); Performance Tests; Titanium Carbides; Stress Intensity Factors; Lubricant Tests; Ball Bearings

19990053876 Artec Aerospace, Toulouse, France

Parametric Measurements on Harmonic Drive Gears

Haddad, Florent, Artec Aerospace, France; Conde, Eric, Centre National d'Etudes Spatiales, France; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 247-260; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper presents the main results of a test program carried out on various harmonic drive (HD) gears by ARTEC under a CNES contract. The objective was to obtain specific information on HD performance. The gears were tested under a space-representative environment (low speed and low torque, Pennzane and Fomblin-based lubrication, from -10 C to 75 C). Various HD configurations were tested in order to study the influence of size, ratio, torque, temperature, material, speed, and lubrication. This paper describes the test bench and presents some of the test program results.

Author

Gears; Mechanical Drives; Lubrication; Performance Tests; Stainless Steels; Transmissions (Machine Elements); Torque

19990053877 TECSTAR, Inc., Electro Systems Div., Durham, NC USA

Development and Qualification of a Motor Drive Unit

Mobley, Jeff, TECSTAR, Inc., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 261-276; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper will discuss one of the primary problems encountered and lessons learned while developing a Motor Drive Unit through a qualification program. The unit was designed to meet specific customer needs, involving narrow restrictions on unit performance and physical envelope. Additionally, the use of brush motors in space requires special considerations to assure that the application is suitable. Testing of brush motors also requires a high degree of caution at the component and system levels to ensure the integrity of the product.

Author

Electric Motors; Electromechanical Devices; Gears; Brushes (Electrical Contacts); Design Analysis; Mechanical Drives; Product Development

19990053879 Naval Research Lab., Washington, DC USA

Flight Operations Experiences with Long Life Mechanisms

Purdy, Bill, Naval Research Lab., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 293-308; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The on orbit history of several different long life mechanisms on a constellation of low earth orbiting satellites will be presented and studied. The satellites are designed for long duration, high reliability operation, and have been in production for many years. Security restrictions prohibit releasing further details on the satellites, however, full disclosure on the mechanisms' history has been approved. There is a rich history to study as all of the mechanisms discussed in this paper have over 10 units with extensive on orbit operation. There were life-related problems encountered in several of the mechanisms that threatened the life of the satellites. These life problems occurred despite the excellent manufacturing and acceptance pedigree of the mechanisms. This fact shows that as satellites are required to operate longer mechanisms can be one of their life-limiting systems.

Author

Mechanical Devices; Design Analysis; Service Life; Redundant Components; Actuators; Tape Recorders; Wheels; Aerospace Systems; Earth Orbits; Systems Analysis

19990053881 Lockheed Martin Missile and Space, Sunnyvale, CA USA

Design and Development of the Gravity Probe B Relativity Mission Mass Trim Mechanism

Zinn, Michael, Lockheed Martin Missile and Space, USA; St.Clair, Dennis, Lockheed Martin Missile and Space, USA; Skoda, Peter, Lockheed Martin Missile and Space, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 325-345; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The design and testing of the Mass Trim Mechanism (MTM), an on-orbit ballast adjustment system for the Gravity Probe B Relativity Mission Space Vehicle, is described. In particular, design details that make the mechanism virtually immune to temperature changes and provide extremely high torque margins while maximizing the mass authority of the mechanism are presented. In addition, challenges faced during the test program such as the difficulty in measuring the low level disturbance forces generated by the MTM are also discussed.

Author

Gravity Probe B; Mechanical Devices; Design Analysis; Control Stability; Aerospace Vehicles; Mass Balance

19990053882 ETEL S.A., Motiers, Switzerland

Gravity Recovery and Climate Experiment and Multifrequency Imaging and Microwave Radiometer Compact Balancing Mechanisms

Baker, Fred C., ETEL S.A., Switzerland; VonSiebenthal, E., ETEL S.A., Switzerland; Favre, E., ETEL S.A., Switzerland; Piaget, D., ETEL S.A., Switzerland; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 347-362; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper summarizes and compares the design, development manufacturing and tests of the Gravity Recovery and Climate Experiment (GRACE) Center of Mass Trim (CMT) Assembly, managed by a joint international U.S. and German team, and the European Space Agency's Envisat Multifrequency Imaging and Microwave Radiometer (MIMR) balancing mechanisms. Each of the two GRACE CMTs comprises both mechanical and electronic subsystems: six Mass Trim Mechanisms (MTM) and one, cold redundant Mass Trim Electronics (MTE). Both subsystems will be discussed with respect to their design details and constraints and their respective development and qualification tests and results. A comparison will be provided between the GRACE and the MIMR mechanisms and the lessons learned for each.

Author

Electromechanical Devices; Mass Balance; Performance Tests; Satellite-Borne Instruments; Measuring Instruments; Aerospace Vehicles; Control Stability; Design Analysis

19990053883 Aeroflex Labs., Inc., Farmingdale, NY USA

Development of a Large Multi-Axis Positioning Mechanism

Sharif, Boz, Aeroflex Labs., Inc., USA; Joscelyn, Ed, Aeroflex Labs., Inc., USA; Smith, Jim, Aeroflex Labs., Inc., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 363-372; In English; See also 19990053852; No Copyright; Avail: CASI; A02, Hardcopy; A04, Microfiche

The Tool Manipulator system is a redundantly (electro-mechanically & electrically) constructed, 3-axis positioning system. The system is comprised of 2 main components, the Three-Axis Positioner (3AP) and the Electronic Control Unit (ECU). The system is designed to operate in a space environment. Onboard software and Digital Signal Processing -based firmware allow the mechanism to perform a variety of positioning and motion tasks through the use of pre-programmed motion routines or under direct software command through a Host Computer interface. Redundant telemetry is provided to the Host Computer for verification of desired motion profile. The requirements of the system were to be able to smoothly move, accurately position and support a 20-kg payload through a travel range of approximately 1200 mm (X) x 250 mm (Y) x 150 mm (Z), while maintaining a dynamic accuracy of 10 microns under a dynamic load of 90 kg, which may be oriented in any direction. The end point(s) was specified to have a load deflection of less than 25 microns during operation. The dynamic load generated a random frequency spectra between 100 to 200 Hz. The system was specified to maintain accuracy requirements in the presence of this disturbance while in operation. Additionally, as a result of cabling to the payload, an additional load of 16 kg was expected to be induced during operation. Due to the redundancy requirements, two end points, parallel to one another at a distance of 250 mm in the X axis were specified, the system was to meet all requirements without any knowledge as to which end point was being employed. As a further challenge, the system was specified to be no bigger than the sum of the specified structural size and the specified travel in each axis. In other words, the envelope dimensions were the same as specified travel ranges in each direction. Finally, the required maximum mass of the system was specified at 76 kg, however, the specifications required that the mechanism was to also support an external load of 680 kg attached to each end of the base. Figure 1 is an overall representation of the 3AP mechanism shown with a simulated 20-kg payload attached to one end point. The challenge was to build the lightest, stiffest and most accurate mechanism feasible within the constraints of the specifications. This paper discusses the strategies used, the pitfalls found and the solutions employed to meet these challenges.

Author

Manipulators; Electromechanical Devices; Electronic Control; Control Equipment; Redundancy; Performance Tests; Equipment Specifications; Aerospace Systems

19990053885 NASA Johnson Space Center, Houston, TX USA

Interim Control Module Extraction Strut Assembly

Hansen, Chris, NASA Johnson Space Center, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 389-403; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The Interim Control Module is a propulsion and attitude control module for the International Space Station developed to serve as a replacement for the Russian Service Module in the event that Russia does not deliver the hardware as expected. The hardware was developed through a joint NASA/Naval Research Laboratory program and is based on a Department of Defense payload. This

paper discusses the development and testing of the Extraction Strut hardware that will be used to assist in removing the Interim Control Module from the Shuttle's payload bay.
Author
International Space Station; Attitude Control; Mechanical Devices; Struts; Space Station Propulsion; Systems Engineering; Performance Tests

19990053886 Fokker Space B.V., Leiden, Netherlands
Fokker Space Solar Array Deployment Rigs
Eggers, Aad P., Fokker Space B.V., Netherlands; Cruijssen, Henk J., Fokker Space B.V., Netherlands; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 405-417; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

A solar array deployment rig is used to simulate the space zero-gravity conditions for ground testing and integration purposes. The quality of the rig is determined by its ability to minimize disturbance forces (static and dynamic) that cause a deviation from the space zero-gravity environment. These disturbance forces are: Weight components acting along the path of the trolley movements, Forces resulting from the trolley accelerations (added mass), Forces resulting from the stiffness and weight of air supply hoses, and Aerodynamic drag and lift forces acting on the deploying panels.
Author
Solar Arrays; Fixtures; Deployment; Environment Simulation; Positioning Devices (Machinery); Design Analysis

19990053887 NASA Langley Research Center, Hampton, VA USA
Wind Tunnel Model Support Cart with Telescoping Mast and Cable Yaw Drive
Gregory, Peyton B., NASA Langley Research Center, USA; Monroe, Charles A., NASA Langley Research Center, USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 419-430; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The 14-by-22 Foot Subsonic Tunnel at NASA Langley Research Center uses model carts to support and position models in the test section. The carts are portable through the use of air bearings and can be moved from the test to the Model Prep Area (MPA) to change models in preparation for a new test. This paper describes the design of a new model cart that is three feet shorter than existing carts. This will eliminate clearance problems when moving the model and cart from the MPA to the test section.
Author
Wind Tunnel Models; Carts; Supports; Test Stands; Wind Tunnel Drives; Mechanical Devices; Design Analysis

19990053888 Sverdrup Technology, Inc., Moffett Field, CA USA
Remote Flap Actuation System for Large-Scale High-Speed Civil Transport Wind Tunnel Model
Kennon, J. E., Sverdrup Technology, Inc., USA; Bisbee, L. S., Sverdrup Technology, Inc., USA; Willink, M. P., Sverdrup Technology, Inc., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 431-446; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The High-Lift Engine Aeroacoustic Technology (HEAT) wind tunnel model has been modified to incorporate remote actuation of the four trailing edge flaps. The cellular arrangement of the wing ribs and spars combined with the thinness of the wing and the requirement to maintain structural integrity imposes severe constraints on the packaging of the flap actuation mechanisms in the model. Simple motion linkage systems are utilized to transmit power from hydraulic cylinders to actuate each of the flap surfaces. This paper describes these individual linkage systems, the flap position measurement systems, problems encountered during the checkout phase, and overall system performance.
Author
Wind Tunnel Models; Flaps (Control Surfaces); Remote Control; Mechanical Devices; Flapping; Design Analysis; Wind Tunnel Apparatus

19990054160 Department of the Navy, Washington, DC USA
Multiline Tow Cable Assembly Including Swivel and Slip Ring
Williams, Michael R., Inventor; Aug. 12, 1998; 23p; In English
Patent Info.: Filed 12 Aug. 1998; US-Patent-Appl-SN-9,137,870
Report No.(s): AD-D019339; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

This patent application discloses a multiline tow cable assembly including swivel area components and slip ring components. The swivel area components include a rotor member connected to an external housing, at least one contact member formed within the rotor member and rotatable with the rotor, and first electrical leads connected to the at least one contact member. The slip ring

components include a multiline termination member, a stator connected to the multiline termination member, at least one contact pin formed in connection with the stator, and second electrical leads connected to the at least one contact pin. A substantially friction free member is interposed between the swivel area components and the slip ring components for enabling relative rotation of the swivel area components with respect to the slip ring components. By the described assemblies, continuous electrical connection is maintained between the first and second electrical leads upon rotation of the swivel area components with respect to the slip ring components.
DTIC
Rotation; Electric Conductors; Electric Connectors; Electric Wire; Friction

19990054165 Department of the Navy, Washington, DC USA
Venturi Muffler With Variable Throat Area
Morhead, Clyde A., Inventor; Henry, John W., Inventor; Oct. 13, 1998; 9p; In English; Supersedes US-Patent-Appl-SN
Patent Info.: Filed 8 MAy. 96,; US-Patent-Appl-SN-646,571; US-Patent-5,821,475
Report No.(s): AD-D019297; No Copyright; Avail: US Patent and Trademark Office, Microfiche
The invention is directed to a muffler for a gas intake at a gas intake of a machine. The muffler includes at least one venturi nozzle cooperating with a chamber. Each venturi nozzle has an inlet opening, an outlet opening and a throat there between. The chamber has a chamber inlet connected to either the inlet opening or the outlet opening of each venturi nozzle. The chamber has a chamber outlet connected to the gas intake of the machine. Some embodiments of the invention feature variation of the total throat area of the muffler. Other embodiments of the invention feature variation of the volume enclosed by the chamber.
DTIC
Mufflers; Venturi Tubes

19990054169 Department of the Navy, Washington, DC USA
Cooled Fixture for High Temperature Accelerometer Measurements
Dubois, Neil J., Inventor; Oct. 13, 1998; 4p; In English; Supersedes US-Patent-Appl-SN
Patent Info.: Filed 28 Apr. 96,; US-Patent-Appl-SN-641,325; US-Patent-5,821,418
Report No.(s): AD-D019301; No Copyright; Avail: US Patent and Trademark Office, Microfiche
The present invention relates to a cooled fixture for high temperature accelerometer measurement. The fixture includes a collar mounted to a pipe and a block mounted to the collar to which one or more accelerometers may he connected. The block is provided with a cooling system for controlling the temperature of the accelerometer(s) mounted to the block and maintaining the temperature at level at which the accelerometers will survive.
DTIC
Accelerometers; High Temperature; Heat Pipes; Temperature Measurement; Fixtures; Pipes (Tubes)

19990054170 Department of the Navy, Washington, DC USA
Variable-Speed Rotating Drive
Moody, Paul E., Inventor; Oct. 13, 1998; 9p; In English; Supersedes US-Patent-Appl-SN
Patent Info.: Filed 28 Apr. 96,; US-Patent-Appl-SN-640,580
Report No.(s): AD-D019302; PATENT,5,819,632; No Copyright; Avail: US Patent and Trademark Office, Microfiche
A variable-speed rotating drive is provided. A drive shaft terminates in a threaded piston that is received in an internally threaded cylinder. A plurality of linear actuators are distributed evenly about the circumferential periphery of the internally threaded cylinder. The drive shaft is mechanically coupled with each shaft of the linear actuators so that axial movement of the linear actuators' pistons causes the threaded piston to move axially in the internally threaded cylinder. This brings about axial rotation of the internally threaded cylinder. An actuating source is coupled to the linear actuators to cause the axial movement of selected ones of the pistons based upon the desired speed of rotation of the internally threaded cylinder.
DTIC
Mechanical Drives; Shafts (Machine Elements); Actuators

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QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

19990053603 NASA Langley Research Center, Hampton, VA USA
Proceedings of the First Annual Symposium for Nondestructive Evaluation of Bond Strength
Roberts, Mark J., Compiler, Army Research Lab., USA; May 1999; 132p; In English; Nondestructive Evaluation of Bond Strength, Nov. 1997, Hampton, VA, USA; Sponsored by NASA, USA; See also 19990053604 through 19990053610
Contract(s)/Grant(s): RTOP 552-18-11-03
Report No.(s): NASA/CP-1999-209137; L-17857; NAS 1.55:209137; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Quantitative adhesive bond strength measurement has been an issue for over thirty years. Utilization of nonlinear ultrasonic nondestructive evaluation methods has shown more effectiveness than linear methods on adhesive bond analysis, resulting in an increased sensitivity to changes in bondline conditions. Correlation to changes in higher order material properties due to microstructural changes using nonlinear ultrasonics has been shown and could relate to bond strength. Nonlinear ultrasonic energy is an order of magnitude more sensitive than linear ultrasound to these material parameter changes and to acoustic velocity changes caused by the acoustoelastic effect when a bond is prestressed. This increased sensitivity will assist in getting closer to quantitative measurement of adhesive bond strength. Signal correlations between non-linear ultrasonic measurements and initialization of bond failures have been successfully measured. This paper reviews nonlinear bond strength research efforts presented by university and industry experts at the First Annual Symposium for Nondestructive Evaluation of Bond Strength organized by the NDE Sciences Branch at NASA Langley in November 1997.
Author
Nondestructive Tests; Bonded Joints; Acoustic Velocity; Microstructure; Joints (Junctions); Failure

19990053604 Georgia Inst. of Tech., Atlanta, GA USA
Ultrasonic Nondestructive Characterization of Adhesive Bonds
Qu, Jianmin, Georgia Inst. of Tech., USA; Jacobs, Larry, Georgia Inst. of Tech., USA; Proceedings of the First Annual Symposium for Nondestructive Evaluation of Bond Strength; May 1999, pp. 38-67; In English; See also 19990053603; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

This project is concerned with the qualification of reliability and integrity of metal/polymer bond joints. The objectives are to: (1) Establish the correlation between microstructural changes and ultrasound propagation characteristics; (2) Develop ultrasonic nondestructive methods to measure the microstructural changes caused by the degradation of bond strength; and (3) Predict remaining bond strength from ultrasonic measurement based on the fundamental structure-property-performance relationship of the constituents and their interfaces.
Derived from text
Adhesive Bonding; Joints (Junctions); Ultrasonics; Microstructure

19990053605 Army Research Lab., Vehicle Technology Directorate, Hampton, VA USA
Bond Strength Program
Roberts, Mark J., Army Research Lab., USA; Proceedings of the First Annual Symposium for Nondestructive Evaluation of Bond Strength; May 1999, pp. 1-19; In English; See also 19990053603; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The main goals are to develop clear understanding of bond strength in general structures, develop NDE methods for measuring bond strength & bond quality levels, and develop prototype system and specifications for bond strength NDE analysis.
Derived from text
Nondestructive Tests; Bonding; Joints (Junctions); Bonded Joints

19990053606 Northwestern Univ., Center for Quality Engineering and Failure Prevention, Evanston, IL USA
An Ultrasonic Technique to Determine the Residual Strength of Adhesive Bonds
Achenbach, J. D., Northwestern Univ., USA; Tang, Zhenzeng, Northwestern Univ., USA; Proceedings of the First Annual Symposium for Nondestructive Evaluation of Bond Strength; May 1999, pp. 68-89; In English; See also 19990053603; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The general objective was to develop an ultrasonic nondestructive technique to assess the adhesive bond strength of adhesive layers by analyzing the nonlinear behavior that accompanies adhesive deterioration. The work on this project is both analytical and experimental in nature.
Derived from text
Adhesive Bonding; Residual Strength; Adhesion; Adhesives

19990053607 Johns Hopkins Univ., Dept. of Materials Science and Engineering, Baltimore, MD USA
Nondestructive Determination of Bond Strength
Berndt, Tobias P., Johns Hopkins Univ., USA; Green, Robert E., Jr., Johns Hopkins Univ., USA; Proceedings of the First Annual Symposium for Nondestructive Evaluation of Bond Strength; May 1999, pp. 90-108; In English; See also 19990053603; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Current projects include loading adhesive bond in shear in MTS machine, ultrasonic tests with shear waves, shear-fatigue adhesive bonding, and use of ultrasound to detect onset of nonlinearity.
Derived from text
Adhesive Bonding; S Waves; Shear Stress; Ultrasonic Tests; Adhesives

19990053608 Commonwealth Scientific and Industrial Research Organization, Telecommunications and Industrial Physics, Sydney, Australia
Preliminary Attempts to Detect Weakness of Adhesive Bonds: Acousto-Elastic Measurements Using Plate Waves
Price, Don, Commonwealth Scientific and Industrial Research Organization, Australia; Proceedings of the First Annual Symposium for Nondestructive Evaluation of Bond Strength; May 1999, pp. 109-127; In English; See also 19990053603; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Work completed includes, delamination of Al-Al bonded joints (and detection of hidden corrosion), detection of foreign material inclusions in composite laminates, measurement of elastic constants of composite laminates, and measurement of bond strength.
Derived from text
Adhesive Bonding; Bonded Joints; Corrosion; Laminates

19990053610 College of William and Mary, Applied Science Dept., Williamsburg, VA USA
Optically Stimulated Electron Emission (OSEE) for Bond Inspection
Welch, Christopher S., College of William and Mary, USA; Proceedings of the First Annual Symposium for Nondestructive Evaluation of Bond Strength; May 1999, pp. 29-37; In English; See also 19990053603; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Optically Stimulated Electron Emission (OSEE), a surface inspection technique introduced by NASA and its contractors to address immediate problems in the manufacture of the Space Shuttle, seems to have untapped potential as an inspection device for many production settings, where surfaces have just been prepared prior to forming bonds. The failure of such bonds has been shown in many cases to be due to surface contamination, and OSEE provides a rapid, non-contact method of assessing the surface. to tap the potential, application studies are needed. These studies can be greatly facilitated by a new instrument which incorporates what has been learned in recent studies of the OSEE operation.
Derived from text
Bonding; Joints (Junctions); Inspection; Contamination

19990053878 Naval Research Lab., Washington, DC USA
Actuator Life Testing Rationale and Lessons Learned
Koss, Steve, Naval Research Lab., USA; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 277-291; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

This paper will discuss an actuator life test that was completed in October 1998. Rather than concentrating on the design of the actuator or its performance during the life test, this paper will discuss the life test rationale and lessons learned from a testing standpoint. The systematic approach to formulate the life test plan will be addressed in depth. Additionally, the test set selection and test set performance will be discussed. Finally, lessons learned about test rationale, test set development, and hands-on testing will be discussed. This paper should be useful for those faced with the difficult task of life testing long-life actuators or mechanisms. Key lessons learned may be found in italics in the body of the text as well as at the end of the paper.
Author
Actuators; Accelerated Life Tests; Service Life; Design Analysis; Equipment Specifications; Bearings; Lubricants

19990054357 American Society for Nondestructive Testing, Inc., Columbus, OH USA

Research in Nondestructive Evaluation, Volume 10

Sachse, Wolfgang, Editor, Cornell Univ., USA; Research in Nondestructive Evaluation; 1998; ISSN 0934-9847; 62p; In English; See also 19990054358 through 19990054360; Copyright; Avail: Issuing Activity (Springer-Verlag New York, Inc., 175 Fifth Ave., New York, NY 10010, USA), Hardcopy, Microfiche

This journal will cover experimental and theoretical investigations dealing with the scientific and engineering bases of NDE, its measurement methodology, and a wide range of applications of materials and structures that relate to the entire life cycle, from manufacture to use and retirement. Illustrative topics include advances in the underlying science of acoustic, thermal, electrical, magnetic, optical, and ionizing radiation techniques and their applications to NDE problems. These problems include nondestructive characterization of a wide variety of material properties and their degradation in service, nonintrusive sensors for monitoring manufacturing and materials processes, new techniques and combinations of techniques for characterizing hidden flaws and distributed damage, standardization concepts and quantitative approaches for advanced NDE techniques, and long-term continuous monitoring of structures and assemblies.

Author

Nondestructive Tests; Evaluation; Degradation; Life (Durability); Composite Materials; Speckle Interferometry; Ultrasonic Tests; Structural Analysis

19990054358 National Tsing Hua Univ., Dept. of Power Mechanical Engineering, Hsinchu, Taiwan, Province of China

Nondestructive Evaluation of Composite Materials by ESPI

Wang, W.-C., National Tsing Hua Univ., Taiwan, Province of China; Day, C.-H., National Tsing Hua Univ., Taiwan, Province of China; Hwang, C.-H., National Tsing Hua Univ., Taiwan, Province of China; Chiou, T.-B., National Tsing Hua Univ., Taiwan, Province of China; Research in Nondestructive Evaluation; 1998; Volume 10, No. 1, pp. 1-15; In English; See also 19990054357

Contract(s)/Grant(s): NSC80-0401-E-007; NSC81-F-SP-007-02; Copyright; Avail: Issuing Activity (Springer-Verlag New York, Inc., 175 Fifth Ave., New York, NY 10010, USA), Hardcopy, Microfiche

Electronic speckle pattern interferometry (ESPI) was used to perform nondestructive evaluation of carbon-fiber reinforced plastic (CFRP) laminate plates containing various sizes and shapes of defects located at different depths. A specially designed vacuum box was used to provide the deformation of the test specimen. Not the same as the traditional ESPI, the decorrelation between two speckle patterns was used to determine the size, and shape of a defect. by using the speckle decorrelation, the location, size and shape of a defect can be easily determined. A series of computer programs was developed on the ESPI system to acquire and analyze the interferometric patterns. Although the detected shape and size do not match well with the originally embedded one, the ESPI procedures developed in this paper should still be a potentially quantitative nondestructive method for detecting the location and size of the detect in composite materials.

Author

Carbon Fiber Reinforced Plastics; Defects; Deformation; Laminates; Nondestructive Tests; Plastic Plates; Speckle Interferometry

19990054359 Ohio State Univ., Dept. of Welding Engineering, Columbus, OH USA

Ultrasonic Study of Environmental Damage Initiation and Evolution in Adhesive Joints

Lavrentyev, A. I., Ohio State Univ., USA; Rokhlin, S. I., Ohio State Univ., USA; Research in Nondestructive Evaluation; 1998; Volume 10, No. 1, pp. 17-41; In English; See also 19990054357

Contract(s)/Grant(s): W-7405-eng-82; Copyright; Avail: Issuing Activity (Springer-Verlag New York, Inc., 175 Fifth Ave., New York, NY 10010, USA), Hardcopy, Microfiche

This article reports on an experimental study of environmental degradation of adhesive joints by an ultrasonic angle beam technique. The technique is based on measurements of the frequency response of the reflection obliquely incident ultrasonic signals from a joint bondline. Ultrasonic measurements were performed using a special ultrasonic goniometer with only one ultrasonic transducer. by this method, the degradation of single lap adhesive joints was studied as a function of exposure in NaCl solutions at 68 C under static tensile load. It was found that joint degradation is accompanied by a shift of the ultrasonic reflection spectrum minimum to a lower frequency. Two stages of adhesive joint environmental degradation can be distinguished: a) a relatively slow adhesive joint degradation dominated by adhesive creep, and b) delamination along the adhesive/adherend interface, leading to failure. Several degradation mechanisms are found in the first stage to affect the position of the spectral minimum. The first is adhesive creep caused by normal-to-bond-plane stress concentration at the joint overlap edges. This mechanism is found to have the dominant effect on the ultrasonic signature. Second, changes of the effective density and elastic moduli of the adhesive layer also affect the spectrum of the reflected signal. The third mechanism is the degradation of the adhesive-adherend interface. In the second stage of the joint degradation process, delamination along the adhesive/adherend interface occurs and is followed

by joint failure. While the time span of the first stage changes significantly from joint to joint, the time span of the second stage (failure by delamination) in our conditions is about 30-40 hours. The delamination results in a significant additional spectral minimum shift to a lower frequency that can be used as an indicator of failure initiation.
Author
Adhesive Bonding; Lap Joints; Nondestructive Tests; Ultrasonic Tests; Ultrasonic Flaw Detection; Delaminating

19990054360 EPCOM Corp., Troy, MI USA
Application of Modal Flexibility and its Derivatives in Structural Identification
Zhang, Z., EPCOM Corp., USA; Aktan, A. E., Cincinnati Univ., USA; Research in Nondestructive Evaluation; 1998; Volume 10, No. 1, pp. 43-61; In English; See also 19990054357; Copyright; Avail: Issuing Activity (Springer-Verlag New York, Inc., 175 Fifth Ave., New York, NY 10010, USA), Hardcopy, Microfiche

Using erroneous test data can be misleading in nondestructive evaluation practice. The objective of this paper is to discuss what experimental data to use and how to mitigate experimental error when a modal test is used. In this paper, the modal flexibility and its derivative. uniform load surface (ULS) are analyzed for their truncation effect and sensitivity to experimental error. The ULS is found to have much less truncation effect and is least sensitive to experimental error. These features make it a critical experimental index in the structural identification as needed in nondestructive evaluation. This paper also discusses how to utilize pretest analysis to determine the test frequency band that will lead to the least truncation error. The ultimate usefulness of the approach presented in this paper is that it can lead to effective and accurate nondestructive evaluation. A numerical example and a real structure, the Cross-Country Highway Bridge in the Cincinnati, Ohio. area, are analyzed for the truncation effect.
Author
Errors; Loads (Forces); Nondestructive Tests; Truncation Errors; Flexibility; Modal Response

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STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

19990053640 Boston Univ., Dept. of Aerospace and Mechanical Engineering, Boston, MA USA
Shock Survivability of Dynamical Systems *Final Report*
Barbone, Paul E.; May 05, 1999; 159p; In English
Contract(s)/Grant(s): N00014-95-1-0283
Report No.(s): AD-A363045; AM-99-006; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

We have studied the dynamic response of very complicated structures to transient shock-related excitation. We have defined a notion of complexity of dynamical substructures. We found that in the limit of infinite complexity, substructures can be accurately represented as very low order dynamical subsystems. We have obtained error bounds and estimates for these approximate representations, and derived older preexisting approximations as special cases of ours.
DTIC
Dynamical Systems; Dynamic Response; Excitation; Mechanical Shock

19990053736 SRI International Corp., Menlo Park, CA USA
Dynamic Failure of Materials. Volume 1 - Experiments and Analyses, *20 May 1993 - 20 Sep. 1996*
Antoun, Tarabay H.; Seaman, Lynn; Curran, Donald R.; Nov. 1998; 342p; In English
Contract(s)/Grant(s): DNA001-93-C-0104; Proj-SB, \ AJ
Report No.(s): AD-A362713; SRI-PYU-4727-VOL-1; DSWA-TR-96-77-V1; No Copyright; Avail: CASI; A15, Hardcopy; A03, Microfiche

Over the past three decades, scientist in the Former Soviet Union (FSU) and in the West have developed innovative experimental techniques, measurement diagnostics, and constitutive models of the Spall Process. Extensive literature has been built up over the years in Western publications. However, much of the FSU work was not available in English and was largely inaccessible to Western readers. Improved communication between Western and FSU scientists since the end of the Cold War now allows the parallel FSU and Western work to be collected, compared, cross-correlated, and examined for new insights and ideas for future directions. The goal of this project was to make formerly inaccessible FSU results available to Western readers and to create a handy reference source for fracture kinetics data, experimental techniques, measurement diagnostics, interpretation methods,

constitutive modeling approaches, and numerical computation approaches and results. We hope this work will be useful to investigators and engineers dealing with fast load and fracture as well as to investigators working in the field of physics of strength.
DTIC
Fracturing; Loads (Forces); Cross Correlation; Kinetics; Mathematical Models

19990053785 Naval Surface Warfare Center, Bethesda, MD USA
Vibration Damping by a Nearly Continuous Distribution of Nearly Undamped Oscillators, *1 Mar. - 30 Apr. 1999*
Maidanik, G., Naval Surface Warfare Center, USA; Jan. 14, 1999; 30p; In English
Report No.(s): AD-A362958; NSWCCD-70-TR--1999-120; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

It has been claimed that vibration damping can be derived from the coupling of a continuous distribution of undamped oscillators. This claim stems from the fact that the contribution to the damping of a master oscillator by a coupled set of continuously distributed satellite oscillators, is independent of the loss factors of the oscillators in this set (The distribution is with respect to the frequency of resonance of the satellite oscillators in the set.) The transition from a discrete-to-a continuous distribution, however, cannot be achieved without the imposition of modal overlap on the distribution of the satellite oscillators. It is this imposition that ensures that the contribution to the damping by these satellite oscillators is intuitively real. The imposition forbids equating the loss factors of the satellite oscillators to zero just because their contribution, to the surrogate damping of the host master oscillator to which they are coupled, is independent of these loss factors. Notwithstanding that the quantification of this contributed damping in terms of a dimensionless ratio of dynamic quantities does not uniquely qualify it as a loss factor. Moreover, the analysis of nearly continuous distribution of nearly undamped satellite oscillators brings insights into the manner by which they contribute damping to the mechanical system of which they are an integral part. In part, these insights are obscured in an analysis that is based on the a priori introduction of extreme limits. Indeed, these insights may be the overwhelming justification for the present paper.
DTIC
Vibration Damping; Undamped Oscillations; Resonant Vibration

19990054315 Naval Surface Warfare Center, Carderock Div., Bethesda, MD USA
Standardized Procedure for Experimental Vibration Testing of Damping Test Specimens *Final Report*
Ratcliffe, Colin P.; Crane, Roger M.; Capone, Dean; Koudela, Kevin; Dec. 1998; 26p; In English
Report No.(s): AD-A363069; NSWCCD-65-TR-1998/21; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The experimental determination of structural or material damping as a function of frequency can be a complicated task. The observed values can apparently change between experiments. This report includes a proposed standardized test procedure which aims to reduce these variations in modal damping. The standard focuses on the four main areas where variations in test procedure can introduce differences: a) preparation and support of the structure; b) selection, preparation and use of transducers and equipment; c) setting up the analyzer, and d) data analysis and reduction.
DTIC
Structural Analysis; Damping; Standardization

42
GEOSCIENCES (GENERAL)

19990053744 Geological Survey, Water Resources Div., Carson City, NV USA
Water Resources Data for Nevada, Water Year 1998 *Annual Report, 1 Oct. 1997 - 30 Sep. 1998*
Preissler, A. M.; Roach, G. A.; Thomas, K. A.; Wilson, J. W.; 1999; 630p; In English
Report No.(s): PB99-147753; USGS/WDR/NV-98/1; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

Water resources data published herein for the 1998 water year comprise the following records: Water discharge for 163 gaging stations on streams, canals, and drains; discharge for 113 peak-flow sttons and miscellaneous sites, and 43 springs; stage and contents for 21 lakes and reservoirs; water quality data for 135 stream, lake, canal, spring, and drain sites, and 41 wells; precipitation totals for 26 stations; and water withdrawals for 14 wells.
NTIS
Water Resources; Data Systems; Data Acquisition; Water Quality; Hydrology

19990054462 Geological Survey, Water Resources Div., Helena, MT USA
Water Resources Data for Montana, Water Year 1998 *Annual Report, 1 Oct. 1997 - 30 Sep. 1998*
Shields, R. R.; White, M. K.; Ladd, P. B.; Chambers, C. L.; Dodge, K. A.; Mar. 26, 1999; 540p; In English

Report No.(s): PB99-140733; USGS/WDR/MT-98/1; No Copyright; Avail: CASI; A23, Hardcopy; A04, Microfiche

Water resources data for Montana for the 1998 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 237 gaging stations; stage and/or content records for 9 lakes and large reservoirs and content for 31 smaller reservoirs; water-quality records for 54 streamflow-gaging stations, 9 ungaged stream sites, and 2 atmospheric deposition stations; and water-level records for 73 observation wells and 5 long-term observation wells equipped with continuous records. Additional water year 1998 data collected at crest-stage gage and miscellaneous measurement sites were collected but are not published in this report. These data are stored within the District office files in Helena and available on request. These data represent part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Montana.

NTIS

Geological Surveys; Data Systems; Waste Water; Water Quality; Water Resources; Hydrology; Surface Water; Ground Water

19990054532 Geological Survey, Water Resources Div., Miami, FL USA

Water Resources Data for Florida, Water Year 1998, Volume 2B, South Florida Ground Water ***Annual Report, 1 Oct. 1997 - 30 Sep. 1998***

Prinos, S.; Overton, K.; Apr. 1999; 562p; In English

Report No.(s): PB99-145047; USGS/WDR/FL-98-2B; No Copyright; Avail: CASI; A24, Hardcopy; A04, Microfiche

Water resources data for 1998 water year in Florida consists of continuous or daily discharge for 307 streams, periodic discharge for 30 streams, continuous or daily stage for 89 streams, periodic stage for 4 streams, peak discharge for 38 streams, and peak stage for 38 streams; continuous or daily elevations for 51 lakes, periodic elevations for 51 lakes; continuous ground-water levels for 439 wells, periodic ground-water levels for 1958 wells; quality of water data for 118 surface-water sites and 267 wells.

NTIS

Water Resources; Data Systems; Data Acquisition; Surface Water; Ground Water; Hydrology; Water Quality

19990054541 Geological Survey, Water Resources Div., Trenton, NJ USA

Water Resources Data for New Jersey, Water Year 1998, Volume 3, Water-Quality Data ***Annual Report, 1 Oct. 1997 - 30 Sep. 1998***

DeLuca, M. J.; Oden, J. H.; Romanok, K. M.; Riskin, M. L.; May 1999; 470p; In English

Report No.(s): PB99-147803; USGS/WDR/NJ-98/3; No Copyright; Avail: CASI; A20, Hardcopy; A04, Microfiche

Water-resources data for the 1998 water year for New Jersey are presented in three volumes, and consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water level and water quality of ground water.

NTIS

Ground Water; Water Resources; Water Quality; Hydrology; Data Systems; Surface Water

19990054542 Geological Survey, Water Resources Div., Tallahassee, FL USA

Water Resources Data for Florida, Water Year 1998, Volume 4, Northwest Florida ***Annual Report, 1 Oct. 1997 - 30 Sep. 1998***

Franklin, M.; Meadows, P.; Alvarez, E.; Apr. 1999; 190p; In English

Report No.(s): PB99-147795; USGS/WDR/FL-98/4; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Water resources data for the 1998 water year in Florida consists of records for continuous or daily discharge for 307 streams, periodic discharge for 30 streams, continuous or daily stage for 89 streams, periodic stage for 4 streams, peak stage and discharge for 38 streams; continuous or daily elevations for 27 lakes, and periodic elevations for 51 lakes; continuous ground-water levels for 439 wells, and periodic ground-water levels for 1,958 wells; quality-of-water data for 118 surface-water sites and 267 wells.

NTIS

Water Resources; Data Systems; Data Acquisition; Ground Water; Hydrology; Water Quality; Surface Water

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EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see 35 Instrumentation and Photography.

19990053730 Naval Air Weapons Station, China Lake, CA USA
Coso Monitoring Program, October 1997 through September 1998
Lager, S. D.; Johnson, B. R.; Jan. 1999; 61p; In English
Report No.(s): AD-A362727; NAWS-CL-TP-011; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Coso Monitoring Program is a continuing effort in support of the Navy's geothermal resources within the Coso Known Geothermal Resource Area (Coso KGRA). A substantial body of reports has been established on this project (15 technical publications) and the project is essentially the same year to year, therefore much of the text of each report reiterates previously published information. This year's report concentrates on data presentation and interpretation; the reader is referred to the 1993/1994 summary report (NAWS-CL TP 006) for detailed descriptions of the overall project and the individual sites monitored.
DTIC
Temperature; Geothermal Resources; Monitors

19990053899 Department of the Navy, Washington, DC USA
Method for Remotely Determining Sea Surface Roughness and Wind Speed at a Water Surface
Anderson, Kenneth D., Inventor; Sep. 15, 1998; 13p; In English; Supersedes US-Patent-Appl-SN-675430
Patent Info.: Filed 26 Jun. 96,; US-Patent-Appl-SN-675,430; US-Patent-5,808,741
Report No.(s): AD-D019324; No Copyright; Avail: US Patent and Trademark Office, Microfiche

Transmitted signals are used to remotely assess sea surface roughness and hence wind speed at a water surface. A signal is transmitted from a signal source as it moves either through air or space. A land- or sea-based antenna receives the signal directly from the signal source and indirectly from the signal source by way of reflection of the signal from the surface being examined. The sum of the directly and indirectly received signals form an interference pattern as the signal source is moved. The interference pattern has peak-to-null signal values that are characteristic of the surface conditions being analyzed. Reference interference patterns are then generated for known surface conditions each of the reference patterns exhibiting "known" characteristic peak-to-null signal values. The peak-to-null signal values of the reference interference patterns are then compared to the peak-to-null signal values generated from the surface being examined. The reference interference pattern having known peak-to-null signal values most closely resembling the peak-to-null signal values generated from the surface being examined is determined. The known surface conditions of this reference interference pattern are then equated with the unknown surface conditions of the surface being examined. by using this technique one can determine the surface conditions of a sea surface as well as the wind speed present at such a surface.
DTIC
Ocean Surface; Wind Velocity; Surface Properties; Seas

19990054150 Cornell Univ., Inst. for the Study of the Continents, Ithaca, NY USA
Digital Database Development and Seismic Characterization and Calibration for the Middle East and North Africa *Final Report, 20 Jun. 1995 - 23 Dec. 1997*
Barazangi, Muawia; Seber, Dogan; Sandoval, Eric; Steer, David; Vallve, Marisa; Feb. 24, 1998; 207p; In English
Contract(s)/Grant(s): F19628-95-C-0092; AF Proj. DENN
Report No.(s): AD-A286992; AFRL-VS-HA-TR-98-0041; No Copyright; Avail: Defense Technical Information Center (DTIC), Microfiche

It is essential for the CTBT monitoring efforts that multidisciplinary information on any given region be readily available and accessible in a digital, on-line format via electronic networks for use by concerned researchers and decision makers. We collected and organized available seismological, geophysical, and geological data sets for the Middle East and North Africa into a comprehensive Geographic Information System (GIS). In addition, we produced original results, such as crustal structure beneath available broadband seismic stations in the Middle East and North Africa region, and basement depth values in the northern Arabian plate. In addition to the GIS databases and tools, we developed a special World Wide Web (WWW) site to allow restricted access to our databases. All the data sets in our GIS system were documented with a standard metadata format in order to explain the source and nature of the data, their resolution, and their accuracy. The developed system and its efficiency in using and analyzing information will help CTBT researchers and decision makers to fuse and integrate the results of the four established monitoring technologies to reach a conclusion in a very short time. The system also significantly contributes to the better location and calibra-

tion of suspect events for any given region. This system will also help in On Site Inspection efforts. Our World Wide Web address for information distribution is http://atlas.geo.cornell.edu.
DTIC
Geographic Information Systems; Remote Sensing; Data Systems; Digital Systems; Data Bases; Seismology; Middle East; Africa

19990054595 National Taiwan Univ., Graduate Inst. of Building and Planning, Taipei Taiwan, Province of China
Accuracy Test and Method Choice for Map Digitization
Lin, Feng-Tyan, National Taiwan Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 79-86; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The measurement of accuracy is one of the most important features of data quality. Many statistical and practical criteria have been set for paper map digitization under various situations and considerations. This article explores the theoretical relationship between statistical and practical accuracy tests, and proposes a framework of cost-accuracy analysis for choosing appropriate digitization methods. Eight trials using three digitization methods on two Taiwan zoning maps with different original qualities were performed to illustrate the differences between statistical and practical methods. The results showed that (1) the test for the mean of the errors should be included in the practical criteria, (2) the error tolerance standard for maps in poor condition can be raised from 0.5mm to 0.3mm, (3) it is sufficient to digitize maps in good condition using the 100dpi-screen method, (4) appropriate digitization methods can be varied according to different map qualities, accuracy criteria, and budget.
Author
Statistical Analysis; Data Correlation; Probability Theory; Statistical Tests; Digital Techniques; Maps

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ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.

19990054449 Helsinki Univ. of Technology, Electron Physics Lab., Espoo, Finland
Electron Physics Laboratory Report, 1998 ***Annual Report***
Mellin, J.; 1999; 48p; In English
Report No.(s): PB99-147464; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Electron Physics Laboratory of Helsinki University of Technology (HUT) gives higher education and carries out research in the fields of integrated circuit and thin film technologies, semiconductor device fabrication and modeling, and semiconductor device physics. Electron Physics Laboratory is a member laboratory of Microelectronics Center at HUT, which provides clean room and semiconductor processing facilities suitable for research purposes.
NTIS
Integrated Circuits; Thin Films; Semiconductor Devices; Education; Electrophysics

45
ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

19990053781 Environmental Protection Agency, Human Exposure and Atmospheric Sciences Div., Research Triangle Park, NC USA
Description and Testing of the AnalTech Model 9801P Monitor for Formaldehyde in Air
McClenny, W. A., Environmental Protection Agency, USA; Jan. 1999; 84p; In English
Report No.(s): PB99-118291; EPA/600/R-98/139; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report incorporates information on the design, operation, and testing of a commercial prototype formaldehyde monitor for ambient and indoor air. The instrument incorporates an innovative light collection system and other features that allow a reduction in instrument size compared to previous instruments of this type and that enable cost-effective commercial production. The report includes an Appendix that provides a definitive description of the instrument (called the Methanalyzer), information on its operation, explanations of its operation in many cases, and also representative data taken with the instrument. The main text

describes the results of independent testing of the instrument in the EPA laboratories. The results of testing show that the instrument offers a viable alternative for network monitoring of formaldehyde at ambient levels in the sub-ppbv to ppbv range.
NTIS
Air Pollution; Formaldehyde; Pollution Monitoring

19990053799 Research Triangle Inst., Research Triangle Park, NC USA
Application of Pollution Prevention Techniques to Reduce Indoor Air Emissions from Engineered Wood Products ***Final Report, Oct. 1993 - Jan. 1998***
Brockmann, C. M., Research Triangle Inst., USA; Sheldon, L. S., Research Triangle Inst., USA; Whitaker, D. A., Research Triangle Inst., USA; Baskir, J. N., Research Triangle Inst., USA; Nov. 1998; 198p; In English
Report No.(s): PB99-118309; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The report gives results of an investigation of pollution prevention options to reduce indoor emissions from a type of finished engineered wood. Emissions were screened from four types of finished engineered wood: oak-veneered particleboard coated and cured with a heat-curable, acid-catalyzed alkyd-urea sealer and topcoat (PBVST); oak-veneered handboard coated and cured with a stain, and a heat-curable, acid-catalyzed alkyd-urea sealer and topcoat (HBVSST); particleboard overlaid with vinyl (PBVY); and particleboard overlaid with melamine (PMB). Within the scope of the emissions and performance tests of the study, three types of coatings were found to have significantly lower emission factors of summed volatile organic compounds (VOCs) and formaldehyde relative to those for the heat-curable, acid-catalyzed alkyd-urea coatings; a two-component waterborne polyurethane, and ultraviolet (UV)-curable acrylate, and a UV-and-heat-curable multi-functional acrylate-free emulsion. Three types of engineered fiber panels were identified as having signficantly lower emission factors of summed VOCs and formaldehyde relative to those for particle-board: medium-density fiberborad made with methylene diisocynate (MDI), a wheat-board panel made with MDI resin, and a panel made from recycled corrugated cardboard.
NTIS
Pollution Control; Indoor Air Pollution; Emission; Composite Materials; Wood; Polyurethane Resins

19990053800 Eastern Research Group, Inc., Morrisville, NC USA
Automated Stationary Source Dynamic Spiking ***Final Report***
McGaughey, J. F., Eastern Research Group, Inc., USA; Bursey, Joan T., Eastern Research Group, Inc., USA; Dayton, Dave-Paul, Eastern Research Group, Inc., USA; Blackard, Andy, Eastern Research Group, Inc., USA; Harrison, Danny, Eastern Research Group, Inc., USA; Jun. 17, 1998; 128p; In English
Report No.(s): PB99-118341; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Methods of collection and analysis for monitoring stationary sources must demonstrate conclusively that the methodology is functioning properly and according to specified EPA criteria. The appropriate procedure for demonstrating proper operation of the method is to perform dynamic spiking of the analyte in the field, at the specified source being monitored. Gaseous dynamic spiking, using certified gas mixtures as the spiking medium has been used in previous EPA stationary source sampling methods and documented in EPA reports. Liquid dynamic spiking, using mixtures of liquid and solid analytes in an organic or aqueous solvent has also been used in previous EPA field tests. to remove, as much as possible, the potential for human error, the EPA has developed a prototype liquid dynamic spiking system employing computerized operation of the analyte spiking procedure with video monitoring and control of the liquid droplet frequency and size. This report describes development of the system, its applicability to stationary source sampling, the individual parts incorporated into the system, and the standard operating procedures.
NTIS
Air Pollution; Emission; Quantitative Analysis; Field Tests; Sampling

19990054126 NASA, Washington, DC USA
Environmental Impact Statement for the Cassini Mission, Supplement 1 ***Final Report***
Jul. 03, 1997; 270p; In English
Report No.(s): NASA/TM-1997-111474/SUPPL1; NAS 1.15:111474/SUPPL1; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This Final Supplemental Environmental Impact Statement (FSEIS) to the 1995 Cassini mission Environmental Impact Statement (EIS) focuses on information recently made available from updated mission safety analyses. This information is pertinent to the consequence and risk analyses of potential accidents during the launch and cruise phases of the mission that were addressed in the EIS. The type of accidents evaluated are those which could potentially result in a release of plutonium dioxide from the three Radioisotope Thermoelectric Generators (RTGS) and the up to 129 Radioisotope Heater Units (RHUS) onboard the Cassini spacecraft. The RTGs use the heat of decay of plutonium dioxide to generate electric power for the spacecraft and instruments.

The RHUs, each of which contains a small amount of plutonium dioxide, provide heat for controlling the thermal environment of the spacecraft and several of its instruments. The planned Cassini mission is an international cooperative effort of the National Aeronautics and Space Administration (NASA), the European Space Agency (ESA), and the Italian Space Agency (ASI) to conduct a 4-year scientific exploration of the planet Saturn, its atmosphere, moons, rings, and magnetosphere.
Author
Cassini Mission; Environment Effects; Spacecraft Launching; Environmental Surveys

19990054127 Research Triangle Inst., Research Triangle Park, NC USA
Proceedings: Low-and No-VOC Coating Technologies: 2nd Biennial International Conference
Darden, E. J., Compiler, Research Triangle Inst., USA; Baskir, J. N., Compiler, Research Triangle Inst., USA; Oct. 1998; 560p; In English; 2nd; Low-and No-VOC Coating Technologies, 13-15 Mar. 1995, Durham, NC, USA
Contract(s)/Grant(s): EPA Order 5D0852NANX
Report No.(s): PB99-118374; No Copyright; Avail: CASI; A24, Hardcopy; A04, Microfiche

The report documents an international conference that provided a forum for the exchange of technical information on coating technologies. It focused on improved and emerging technologies that result in fewer volatile organic compound (VOC) and toxic air emissions than those from traditional coatings. It was held on March 13-15, 1995, in Durham, NC. Technical papers described new coating technologies, coating application equipment, chemical agents for coatings removal, and issues associated with measuring the VOC content of coatings. The technical papers presented at the conference focused on regulations, radiation-curable coatings, life cycle analysis of coatings, surface preparation, powder coatings, automotive applications, wood furniture technologies, military applications, architectural and industrial maintenance coatings, and other low- and no-VOC coating technologies.
NTIS
Conferences; Organic Compounds; Coating; Emission; Protective Coatings

19990054141 NASA Goddard Space Flight Center, Greenbelt, MD USA
Assessment of the Effects of High-Speed Aircraft in the Stratosphere: 1998
Kawa, S. Randolph, NASA Goddard Space Flight Center, USA; Anderson, James G., Harvard Univ., USA; Baughcum, Steven L., Boeing Co., USA; Brock, Charles A., Denver Univ., USA; Brune, William H., Pennsylvania State Univ., USA; Cohen, Ronald C., California Univ., USA; Kinnison, Douglas E., National Center for Atmospheric Research, USA; Newman, Paul A., NASA Goddard Space Flight Center, USA; Rodriguez, Jose M., Miami Univ., USA; Stolarski, Richard S., NASA Goddard Space Flight Center, USA; Waugh, Darryn, Johns Hopkins Univ., USA; Wofsy, Steven C., Harvard Univ., USA; June 1999; 232p; In English
Report No.(s): NASA/TP-1999-209237; Rept-99B00055; NAS 1.60:209237; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This report assesses the potential atmospheric impacts of a proposed fleet of high-speed civil transport (HSCT) aircraft. The purpose of the report is to assess the effects of HSCT's on atmospheric composition and climate in order to provide a scientific basis for making technical, commercial, and environmental policy decisions regarding the HSCT fleet. The work summarized here was carried out as part of NASA's Atmospheric Effects of Aviation Project (a component of the High-Speed Research Program) as well as other NASA, U.S., and international research programs. The principal focus is on change in stratospheric ozone concentrations. The impact on climate change is also a concern. The report describes progress in understanding atmospheric processes, the current state of understanding of HSCT emissions, numerical model predictions of HSCT impacts, the principal uncertainties in atmospheric predictions, and the associated sensitivities in predicted effects of HSCT'S.
Author
Atmospheric Composition; Atmospheric Effects; Civil Aviation; Transport Aircraft; Supersonic Commercial Air Transport; Ozone Depletion; Stratosphere

19990054525 Battelle Memorial Inst., Columbus, OH USA
Evaluation of Air Emissions-Reduction Technologies for Aerospace Ground Equipment ***Final Report, 25 Jul. 1995 - 31 Dec. 96f***
Reuther, James J.; Apr. 1998; 85p; In English
Contract(s)/Grant(s): F33657-92-D-2055; AF Proj. 2745
Report No.(s): AD-A359478; AFRL-HE-WP-TR-1998-0026; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Reported are results of a U.S. Air Force effort to reduce air emissions from aerospace ground equipment (AGE), called the "Green Age" initiative. In Phase I, promising NOx-reduction technologies were identified for deployment on A/M32A-86("-86") generators at March AFB, California. In Phase II, Battelle was contracted to devise and use a numerical rating system by which to evaluate these technologies for merit. The Rating system had five criteria, totally 100 points: Emission Reduction (25), Cost

(25), Reliability/Maintainability (20), Deployability (20), and Fidelity of Data (10). A reduction in NOx of greater than or equal 70% was the prime requirement, with no accompanying increase in the emission of carbon monoxide, particulates, or reactive hydrocarbons. Based on this numerical Rating system, the six candidate Green Age NOx-reduction technologies considered were ranked in the following order of decreasing merit: (1) Water-in-Fuel Firing (WFF), WL/FIVC, Tyndall AFB FL; (2) Selective Catalytic Reduction (SCR), Houston Industrial Silencing (HIS) TX; (3) NOx-Filter Cart (NFC), AL/EQ, Tyndall AFB FL; (4) Dual-Fuel Firing (DFF), BKM, San Diego CA; (5) Oxygen-Enriched Air (OEA), AL/FTS, Brooks AFB TX; and (6) Non-Thermal Discharge (NTD), WL/MNMW, Eglin AFB FL. WFF is less than 5CR, and NFC are recommended for further development and demonstration under Green AGE Phase III. DFF, OEA, and NTD have technical deficiencies, the resolution of which is doubtful, technically or within time.
DTIC
Ground Support Equipment; Environment Effects; Air Pollution; Pollution Control; Air Quality; Aerospace Systems

19990054538 Office of Air Quality Planning and Standards, Research Triangle Park, NC USA
Hospital/Medical/Infectious Waste Incinerator Emission Guidelines: Summary of the Requirements for Section 111(d)/129 State Plans
Nov. 26, 1997; 352p; In English
Report No.(s): PB99-134868; EPA/456/R-97/007; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche
This document addresses the regulations that have been developed for hospital/medical/infectious waste incinerator(s) (HMIWI) under sections 111 and 129 of the Clean Air Act. Section 111 of the Clean Air Act addresses Standards of Performance for Stationary Sources. Section 129 addresses Solid Waste Combustion. Section 1 of this document provides an overview of regulatory and State Plan requirements; section 2 presents information on the timeline and responsibilities for developing and submitting State Plans; and section 3 discusses the required elements of a State Plan. The appendices to this document contain reference and explanatory materials, including: (1) frequently asked questions and answers; (2) copies of the HMIWI NSPS and Emission Guidelines; (3) a fact sheet on the Emission Guidelines; (4) clarifications of the requirements and applicability of the Emission Guidelines; (5) contacts for further information; (6) emission factors for calculating HMIWI air pollutant emissions; and (7) references on health effects of pollutants.
NTIS
Air Pollution; Incinerators; Regulations; Solid Wastes; Hospitals; Pollution Control; Waste Disposal

19990054539 Office of Air Quality Planning and Standards, Research Triangle Park, NC USA
Municipal Waste Combustion: Background Information Document for Federal Plan. Public Comments and Responses
McClintock, J.; Aug. 20, 1998; 30p; In English
Report No.(s): PB99-134975; EPA/456/R-98/005; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This document addresses the comments raised during the comment period for the Federal Plan Proposal for the Large Municipal Waste Combustors. The rule was adopted November 12, 1998.
NTIS
Incinerators; Air Pollution; Wastes; Combustion Products; Emission; Pollution Control; Waste Management

19990054652 Lawrence Livermore National Lab., Livermore, CA USA
Initial Designs of Electric-Discharge Non-Thermal Plasma Field-Pilot Demonstration Units for NOx Removal in Jet-Engine Exhaust: White Paper for SERDP Project CP-1038
Rasocha, L. A., Lawrence Livermore National Lab., USA; Chang, J.-S., Lawrence Livermore National Lab., USA; Miziolex, A. W., Lawrence Livermore National Lab., USA; Aug. 20, 1998; 16p; In English
Contract(s)/Grant(s): W-7405-ENG-36
Report No.(s): AD-A363430; LA-UR-98-5345; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Incentives for implementing new pollution-control technologies are both regulatory and economic. Given considerable regulatory pressure, e.g., the promulgation of a NESHAPS for NOx emissions in CY 2000, new de-NOx technologies are being explored. This project is currently evaluating non-thermal plasma (NTP) technologies for treating jet-engine exhaust and other hazardous air pollutants. to meet a project milestone this White Paper will present our initial design options for NTP reactor systems for a field-pilot demonstration on Cruise Missile Test Cell (CMTC) exhaust at Tinker AFB. The field-pilot demonstration is necessary to provide further data and operating experience to more fully evaluate economic and performance projections for NTP de-NOx technology and to design larger systems with confidence. From the design options presented here, we will downselect the set to 2 treatment systems and consider fielding both. If the budget is not sufficient for 2 reactor systems, only one will be fielded. This paper will discuss the exhaust stream to be addressed, the test setup, the candidate reactor systems, and projected

operating parameters and specifications for the field-pilot units. Because the cost and logistics of using an electron-beam NTP reactor are, respectively, too high and too complicated for this project, we have limited our candidate systems to those based on electric-discharge-driven NTP reactors (which previous economic analyses have shown to be more cost effective).
DTIC
Nitrogen Oxides; Exhaust Emission; Pollution Control; Design Analysis; Electric Discharges; Exhaust Gases; Jet Engines; Air Pollution; Test Facilities

46
GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see 93 Space Radiation.

19990053694 Mitre Corp., Jason Program Office, McLean, VA USA
Characterization of Underground Facilities
Cornwall, J.; Despain, A.; Eardley, D.; Garwin, R.; Hammer, D.; Apr. 1999; 69p; In English
Report No.(s): AD-A363359; JSR-97-155; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
JASON undertook a study at DARPA's request to look for new opportunities for progress in the detection and characterization of UGFs. Part of our charge was to identify the most promising technology areas for investment, emphasizing standoff and covert sensor techniques. The study therefore surveyed a wide range of approaches, and we received numerous briefings. These included summaries of the technology programs of various agencies and briefings from organizations and companies on specific technology approaches. In addition various new ideas were suggested by JASON contributors.
DTIC
Underground Structures; Organizations

19990053740 Iowa Univ., Iowa City, IA USA
High Resolution Computerized Ionospheric Tomography Systems ***Final Report, May 1995 - Sep. 1998***
Na, Helen; Apr. 22, 1999; 87p; In English; Prepared in cooperation with California Univ., Los Angeles, CA.
Contract(s)/Grant(s): N00014-95-1-0850; N00014-97-1-0419
Report No.(s): AD-A362662; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
Research has focused on the development, characterization and implementation of algorithms for time varying ionospheric imaging. Several techniques were used including neural network based approaches for imaging localized time varying events, an iterative volumetric approach for three-dimensional imaging that enables localized incorporation of a priori information, and a technique that utilizes both TEC data as well as information from the WSBI system. Considerable effort was made to analyze the strengths and weaknesses of the various approaches and their inherent limitations. Tests were made using both real and simulated data.
DTIC
Neural Nets; Computerized Simulation; Ionospheres

19990054522 Naval Research Lab., Washington, DC USA
Evidence of High Power HF Radiowave Self-Focusing in the Ionosphere: Preliminary Report of SURA-WIND Observations ***Interim Report***
Rodriguez, P.; Keskinen, M.; Tokarev, Yu. V.; Alimov, V. A.; Belov, Yu. I.; Jan. 29, 1999; 9p; In English
Report No.(s): AD-A359489; NRL/MR/6750--99-8312; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Experiments are currently being conducted using the Russian SURA ionospheric research facility in conjunction with the NASA/WIND satellite. One objective is to investigate the effects of interactions of high power, high frequency radiowaves with the earth's ionosphere. Recent experiments indicate that structured space plasmas along the propagation path impose a power law spectrum of intensity fluctuations on the transmitted waves, similar to scintillations. However, because the transmitted wave frequencies are near ionospheric plasma frequencies, other types of wave-plasma interactions may occur. One possible wave-plasma interaction is the self-focusing instability. In this brief report, we discuss preliminary results that suggest self-focusing was observed. The measurements can provide an important new diagnostic tool of high power radiowave interactions with the underdense ionosphere.
DTIC
Earth Ionosphere; Plasma Frequencies; Radio Waves; Space Plasmas; Self Focusing; High Frequencies

47
METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

19990053809 Schafer Corp., Arlington, VA USA
Support for NAWC-China Lake SSGM Cloud Generation Utility
Feb. 1999; 6p; In English
Contract(s)/Grant(s): N00014-97-D-2014
Report No.(s): AD-A361753; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The objective of this task is to provide the UAV-BPI IRST development effort with a utility for producing cloud scenes for use in the Synthetic Scene Generation Model (SSGM). As currently configured, SSGM comes with only a handful of cloud scenes, which are not necessarily adequate to fully represent the range of cloud conditions in the theaters of interest. The cloud generation utility produced under this effort utilizes historical cloud coverage data for the regions of interest to produce cloud scenes representative of the location and time of year.
DTIC
Scene Generation; Cloud Physics

48
OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also 43 Earth Resources and Remote Sensing.

19990053788 Lamont-Doherty Geological Observatory, Palisades, NY USA
Deep Water Formation and Circulation in the Arctic Ocean Studies by Natural and Anthropogenic Tracers ***Final Report, 31 Mar. 1994 - 30 Sep. 1996***
Schlosser, Peter, Lamont-Doherty Geological Observatory, USA; Mar. 01, 1999; 5p; In English
Contract(s)/Grant(s): N00014-94-1-0507
Report No.(s): AD-A363047; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Funds were requested for completion of measurements of tracer samples (tritium, helium isotopes, oxygen isotopes, C14) from the ARCTIC 91 expedition, as well as for the interpretation of these data. Additionally, funds were requested for participation in an icebreaker expedition to the Arctic Ocean originally planned for 1995. This cruise could not be organized. Therefore, the funds were used for sample collection in the framework of the 1994 joint U.S./Canada Arctic ocean section (AOS 94).
DTIC
Arctic Ocean; Deep Water; Water Circulation; Oceanography

19990053803 California Univ., San Diego, California Sea Grant Coll. System, La Jolla, CA USA
California Sea Grant: Report of Completed Projects, *1994 - 1997*
1998; 262p; In English
Contract(s)/Grant(s): NOAA-NA-66RG0477
Report No.(s): PB99-126963; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The paper contains the following sections: Introduction; Coastal Resources; Aquaculture; Fisheries; New Marine Products; Ocean Engineering and Instrumentation; Marine Affairs; Rapid Response; Education; Continuing Projects; and Appendices.
NTIS
Environment Protection; Fisheries; Marine Resources; Marine Technology; Biological Diversity

19990053827 Communications Research Lab., Tokyo, Japan
Molecular Mechanism of Force and Movement Generated by Motor Proteins
Nakayama, Harute, Communications Research Lab., Japan; Yamasaki, Hiromichi, Communications Research Lab., Japan; Sakakibara, Hitoshi, Communications Research Lab., Japan; Yamada, Akira, Communications Research Lab., Japan; Kojima, Hiroaki, Communications Research Lab., Japan; Kunioka, Yuki, Communications Research Lab., Japan; Oiwa, Kazuhiro, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 651-660; In Japanese; See also 19990053822; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Genius information-processing functions of biological cells are based on elementary processes at the level of macromolecules and molecular assemblies. Outstanding characteristics or macro-molecules and assemblies are their self-regulation and adaptability. to study these characteristics and to mimic their functions, it is essential to observe and analyze the elementary processes at the single molecule level. We, therefore, established the in vitro assay in which motor proteins (myosin, dynein and kinesin) were adsorbed on glass surface while retaining their functions. Force and movement generated by a few number of motor proteins were measured with nm- and pn-scale precision, using the in vitro motility assay combined with optical tweezers or force measurement with a fine glass needle. We also developed the fluorescence microscope with extremely-low background light, which enables us to observe single fluorescent molecules under aqueous conditions. Using this microscope, we measured the rate of ATP turnover by motor proteins at the single molecule level. The principle used in this measurement would be applicable to other biological system such as protein-DNA interaction. Combining the in vitro motility assay and the single-molecule observation would lead the elucidation of the mechanochemical coupling of motor proteins.
Author
Molecules; Cells (Biology); Research; Automatic Control; Data Processing; Macromolecules; Optical Measurement

19990053828 Communications Research Lab., Tokyo, Japan
Fluorescence Imaging of Cellular Structures
Hiraoka, Yasushi, Communications Research Lab., Japan; Haraguchi, Tokuko, Communications Research Lab., Japan; Ding, Da-Qiao, Communications Research Lab., Japan; Chikashige, Yuji, Communications Research Lab., Japan; Yamamoto, Ayumu, Communications Research Lab., Japan; Nabetani, Akira, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 661-669; In Japanese; See also 19990053822; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

We describe fluorescence microscope methodology for imaging specific molecular components within a living cell. Specific aims of our studies have been: (1) to develop multiple wavelength, three-dimensional fluorescence microscopy for imaging cellular structures in high resolution. (2) to develop fluorescence microscopy methods for imaging specific molecular components within a living cell. (3) to analyze nuclear structures during mitosis and meiosis in mammalian cells. (4) to analyze nuclear organization of chromosomes in fission yeast meiosis.
Author
Procedures; Fluorescence; Microscopy; Cells (Biology); Nuclear Structure; Imaging Techniques

19990054485 Marine Biological Lab., Woods Hole, MA USA
The Cytoskeleton: Mechanical, Physical, and Biological Interactions
1996; 100p; Repr. from The Biological Bulletin, v. 194, Jun. 1998; In English, 15-17 Nov. 1996, Woods Hole, MA, USA; Sponsored by Center for Advanced Studies in the Space Life Sciences, USA; See also 19990054486 through 19990054511; Original contains color illustrations
Contract(s)/Grant(s): NCC2-896; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

This workshop, entitled "The Cytoskeleton: Mechanical, Physical, and Biological Interactions," was sponsored by the Center for Advanced Studies in the Space Life Sciences at the Marine Biological Laboratory. This Center was established through a cooperative agreement between the MBL and the Life Sciences Division of the National Aeronautics and Space Administration. To achieve these goals, the Center sponsors a series of workshops on various topics in the life sciences. Elements of the cytoskeleton have been implicated in the effects of gravity on the growth of plants fungi. An intriguing finding in this regard is the report indicating that an integrin-like protein may be the gravireceptor in the internodal cells of Chara. Involvement of the cytoskeleton in cellular graviperception of the basidiomycete Flammulina velutipes has also been reported. Although the responses of mammalian cells to gravity are not well documented, it has been proposed that integrins can act as mechanochemical transducers in mammalian cells. Little is known about the integrated mechanical and physical properties of cytoplasm, this workshop would be the best place

to begin developing interdisciplinary approaches to the effects of mechanical stresses on cells and their most likely responsive cytoplasmic elements- the fibrous proteins comprising the cytoskeleton.
Derived from text
Cells (Biology); Cytoplasm; Gravireceptors; Gravitation; Gravitational Effects; Conferences; Cytology

19990054486 Childrens Hospital Medical Center, Dept. of Pathology and Surgery, Boston, MA USA
Cellular Basis of Mechanotransduction
Ingber, Donald E., Childrens Hospital Medical Center, USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 323-327; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Physical forces, such as those due to gravity are fundamental regulators of tissue development. to influence morphogenesis, mechanical forces must alter growth and function. Yet little is known about how cells convert mechanical signals into a chemical response. This presentation attempts to place the potential molecular mediators of mechanotransduction within the context of the structural complexity of living cells.
Derived from text
Cells (Biology); Gravitation; Cytology; Physiology

19990054487 Clarkson Univ., Dept. of Physics, Potsdam, NY USA
Surface Tension and Viscoelastic Properties of Embryonic Tissues Depend on the Cytoskeleton
Forgacs, Gabor, Clarkson Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 328-330; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

This presentation describes a method for defining ans simultaneously measuring the surface tensions and viscoelastic properties of tissues. Spherical cell aggregates are placed between the plates of specifically designed parallel plate apparatus, compressed with a known force, and allowed to equilibrate. The surface tension is determined from the equilibrium force and the change in shape of the aggregate using Laplace;s equation. Measurement of the surface tension of several embryonic tissues are presented and correlated with the mutual spreading behavior of these tissues. It is demonstrated that tissue surface tension is indeed a well-defined intensive physical parameter: it does not depend on sample variability of the specific conditions under which it was measured. In particular, it is independent of the size of the aggregate and the magnitude of the compressive force.
Derived from text
Interfacial Tension; Viscoelasticity; Cells (Biology)

19990054488 Simon Fraser Univ., Dept. of Physics, Burnaby, British Columbia Canada
Two-Dimensional Cytoskeletons Under Stress
Boal, David H., Simon Fraser Univ., Canada; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 331-333; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Planar triangular networks under stress are predicted to have several interesting properties: a first order transition to a collapse state for a range of compressive stresses and a negative Poisson ratio for a range of tensions. When these two-dimensional nets are allowed to fluctuate in three dimensions, they are predicted to be asymptotically rigid at long length scales and to have a universally negative Poisson ratio, even at zero stress. Not all networks are isotropic: the peptidoglycan network of the bacterial cell wall is ansiotropic in the network plane, being stiff in one direction but soft in the other. One well-studied network is the membrane-associated cytoskeleton of the human red blood cell; a two dimensional network whose elements are tetramers of the protein spectrin.
Derived from text
Cells (Biology); Compressibility; Proteins; Stress Distribution; Bionics

19990054489 Brigham and Women's Hospital, Experimental Medicine Div., Boston, MA USA
Cytoskeletal Networks and Filament Bundles: Regulation by Proteins and Polycations
Jamney, Paul A., Brigham and Women's Hospital, USA; Kaes, Josef, Brigham and Women's Hospital, USA; Shah, Jagesh V., Brigham and Women's Hospital, USA; Allen, Philip G., Brigham and Women's Hospital, USA; Tang, Jay X., Brigham and Women's Hospital, USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 334-336; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The three-dimensional polymer network formed by the cytoskeleton is the main determinant of cellular mechanics and is required for the cell to resist external forces as well as to generate and transmit the forces used during cell motility. Three types

of protein filaments - microtubles, F-actin, and intermediate filaments form the basis of the cytoskeleton. The paper discusses the different roles, the types of cytoskeletal assembly, and the viscoelastic properties of networks formed by the filament types.
Derived from text
Proteins; Viscoelasticity; Cells (Biology); Cytology; Cations; Filaments

19990054491 Medical Research Council, Lab. of Molecular Biology, Cambridge, UK
Amoeboid Motility Without Actin: Insights Into the Molecular Mechanism of Locomotion Using the Major Sperm Protein (MSP) of Nematodes
Stewart, Murray, Medical Research Council, UK; Roberts, Thomas M., Florida State Univ., USA; Italiano, Joseph E., Jr., Florida State Univ., USA; King, Karen L., Florida State Univ., USA; Hammel, Robin, Florida State Univ., USA; Parathasathy, G., Florida State Univ., USA; Bullock, Timothy L., Medical Research Council, UK; McCoy, Airlee J., Medical Research Council, UK; Kent, Helen, Medical Research Council, UK; Haaf, Andreas, Medical Research Council, UK; Neuhaus, David, Medical Research Council, UK; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 342-344; In English; See also 19990054485
Contract(s)/Grant(s): NIH-GM-29994; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The simplicity and specialization of nematode sperm allow for the investigation of the molecular principles underlying amoeboid cells. These sperm crawl at up to 50 micron / minutes by extending a pseudopod packed with bundles of cytoskeletal filaments that can be observed in vivo by light microscopy. The studies on the molecular mechanism of nematode sperm amoeboid motility, reported herein, have emphasized the contributions made by vectorial assembly and filament bundling. It is likely that these features also make a major contribution to motility in actin-based systems.
Derived from text
Locomotion; Cells (Biology); Cytology; Cytoplasm; Proteins

19990054492 Massachusetts Univ. Medical Center, Worcester, MA USA
Role of Ponticulin in Pseudopod Dynamics, Cell-Cell Adhesion, and Mechanical Stability of an Amoeboid Membrane Skeleton
Luna, Elizabeth J., Massachusetts Univ. Medical Center, USA; Hitt, Anne L., Massachusetts Univ. Medical Center, USA; Shutt, Damon, Iowa Univ., USA; Wessels, Deborah, Iowa Univ., USA; Soll, David, Iowa Univ., USA; Jay, Pat, Washington Univ., USA; Hug, Chris, Washington Univ., USA; Elson, Elliot L., Washington Univ., USA; Vesley, Alex, Toronto Univ., Canada; Downey, Gregory P., Toronto Univ., Canada; Wang, Michael, Princeton Univ., USA; Block, Steven M., Princeton Univ., USA; Sigurdson, Wade, State Univ. of New York, USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 345-347; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Ponticulin is a transmembrane protein that constitutes the major high-affinity link between the actin cytoskeleton and the plasma membrane of the soil amoeba Dictyostellim Discoideum. The function of ponticulin in vivo is being deduced by analyzing mutant amoebae in which the single-copy ponticulin gene has been disrupted by homolgous recombination. The observations from the research, which this paper reports on, suggests that one role of ponticulin-based membrane skeleton is to modulate or to negatively regulate cell-cell adhesion. This paper also reports on other experiment in which the role of the membrane skeleton during cellular resistance to various types of mechanical stress has been studied. The results suggest that all of the mechanical techniques employed measure structural properties of the cell cortex rather than of the membrane skeleton. Ongoing research is focused on understanding the function and regulation of ponticulin during cell movement and adhesion and on the identification of structural and functional analogs of ponticulin in higher organisms.
Derived from text
Proteins; Cells (Biology); Microorganisms; Locomotion; Cytology; Cytoplasm; Cell Membranes (Biology)

19990054493 Massachusetts Univ. Medical Center, Dept. of Physiology, Worcester, MA USA
Cell Locomotion and Focal Adhesions are Regulated by the Mechanical Properties of the Substrate
Pelham, Robert J., Jr., Massachusetts Univ. Medical Center, USA; Wang, Yu-Li, Massachusetts Univ. Medical Center, USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 348-350; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Cell-cell adhesion and cell-substrate adhesion are important interactions that modulate intracellular signalling pathways, as well as various cellular events from gene expression to cell locomotion. The full response to adhesion seems to involve not only the cross-linking of integrins but also mechanical input through these receptors. to explored this possibility we have examined

the motility and cytosekeletal organization of NRK epithelial cells and 3T3 fibroblasts cultured on substrates having varying mechanical properties.
Derived from text
Adhesion; Locomotion; Mechanical Properties; Cells (Biology); Cell Membranes (Biology); Cytology; Substrates

19990054494 Michigan Univ., Dept. of Physics and Biophysics, Ann Arbor, MI USA
Theoretical Models of Viscoelasticity of Actin Solutions and the Actin Cortex
Mackintosh, F. C., Michigan Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 351-353; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The elastic response of plant and animal cells depends on a network of protein filaments that form the cytoskeleton. This is a complex and highly dynamic composite of filamentous proteins, together with a range of accessory proteins for initiating and terminating polymerization, introducing cross-links and forming lateral arrays or bundles of filaments. A principal component of this is the actin cortex which is itself an entangled and cross-linked network of F-actin. This paper describes a model that can account for the large shear moduli observed for the actin networks. A shear modulus is predicted, G varies as (kappa(exp 2)/kT)Xi(exp -5) varies as (kappa(exp 2)/kT)(ac(sub A) (exp 5/2)) for densely crosslinked gels, where kappa is the filament stiffness, k is the Boltzmann's constant, T is the temperature Xii is the so called mesh size, c(sub A) is the concentration of actin monomers of size a comprising the filaments. For somewhat weaker concentration and filament stiffness dependencies are predicted by: G varies as Kappa (kappa/kT)(exp 2/5)(ac(sub A) (exp 11/5)). This paper also reports on ongoing experimental and theoretical characterizations of local viscoelasticity of actin solutions as observed with embedded micrometer-size particles.
Derived from text
Mathematical Models; Proteins; Viscoelasticity; Cells (Biology); Shear Stress; Cell Membranes (Biology)

19990054495 Columbia Univ., Dept. of Anatomy, New York, NY USA
Stabilization and Functional Modulation of Microtubules by Microtubule-Associated Protein 4
Nguyen, H. L., Columbia Univ., USA; Gruber, D., Columbia Univ., USA; McGraw, T., Columbia Univ., USA; Sheetz, M. P., Columbia Univ., USA; Bulinski, J. C., Columbia Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 354-357; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Microtubule (MTs) are hollow cytoplasmic fibers that are composed of dimeric protein called tubulin, as well as several MT associated proteins (MAPs) bound along their surface. MTs are believed to play important roles in a variety of cellular processes, including mitosis, cell motility and intracellular vesicle transport. MAPs have been postulated to function as in vivo regulators of the dynamics and functions of MTs. MAP4 is an assembly-promoting MAP, which is expressed throughout all tissues of vertebrate organisms. The researchers hypothesized that MAP4 plays roles in the regulation of MT dynamics, MT organization and MT-based transport porcesses in vivo. It was found that overexpressed MAP4 can contribute to MT stabilization, can affect cell growth parameters, and can inhibit vesicle motility in vivo.
CASI
Cytology; Cytoplasm; Proteins; Cells (Biology)

19990054496 Columbia Univ., Dept. of Cell Biology, New York, NY USA
Microtubules as Determinants of Cellular Polarity
Gundersen, Gregg G., Columbia Univ., USA; Kreitzer, Geri, Columbia Univ., USA; Cook, Tiffani, Columbia Univ., USA; Liao, Guojuan, Columbia Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 358-360; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Most eukaryotic cells respond to developmental or environmental stimuli with a change in their polarity. Inherent in this behavior is the ability of the cell to detect the extracellular cue, to transmit a signal across a plasma membrane, and to translate the signal into molecules that can produce the requisite architecture of change. The overall response could be modulated by the expression of new genes, but since many such responses can be generated without new genetic input, this is not an essential feature of the response. We have been asking, how elements of the cytoskeleton, especially microtubules (MTs) contribute to the generation of cellular polarity by responding to environmental cues and transmitting the information to other cellular constituents. Unlike other signal transduction systems, the one involving MTs mediates a cellular response that reflects the spatial information provided by the original extracellular cue. Individual elements of this system will be described, and the possible mechanisms by which cells achieve functional polarity.
Derived from text
Membranes; Polarity; Cells (Biology); Cell Membranes (Biology); Cytology; Polarization

19990054497 Northwestern Univ., Dept. of Cell and Molecular Biology, Chicago, IL USA

Intermediate Filament Cytoskeletal System: Dynamic and Mechanical Properties

Goldman, R. D., Northwestern Univ., USA; Clement, S., Northwestern Univ., USA; Khuon, S., Northwestern Univ., USA; Moir, R., Northwestern Univ., USA; Trejo-Skalli, A., Northwestern Univ., USA; Spann, T., Northwestern Univ., USA; Yoon, M., Northwestern Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 361-363; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Intermediate filaments (IF) are major cytoskeletal constituents of animal cells. For many years they were thought to be the most stable of all of the different cytoskeletal systems. Recently, however, IF have been shown to be in a state of dynamic equilibrium in growing cells. The exchange between IF subunits and their polymers appears to be regulated by phosphorylation catalyzed by different kinases and dephosphorylation catalyzed by phosphatases. We have exploited this equilibrium state in vivo through the uses of mimetic peptides that are known to drive vimentin IF disassembly and to inhibit subunit polymerization into IF at 1:1 molar ratios in vitro. We have also shown that there are no detectable effects of the wild type peptide on either the stability or polymerization of microtubules and actin at 3-5 molar excesses in vitro. When these peptides are injected into live cells, containing vimentin IF, they rapidly induce the disassembly of IF networks. The disassembly of IF in vivo is accompanied by dramatic changes in cell shape and mechanical properties.

Derived from text

Dynamic Characteristics; Polymerization; Stability; Cells (Biology); Cytology; Filaments; Mechanical Properties

19990054498 Johns Hopkins Univ., Dept. of Biological Chemistry, Baltimore, MD USA

Type 1 Keratin 16 Forms Relatively Unstable Tetrameric Assembly Subunits With Various Type 2 Keratin Partners: Biochemical Basis and Functional Implications

Coulombe, Pierre A., Johns Hopkins Univ., USA; Wawersik, Matthew, Johns Hopkins Univ., USA; Paladini, Rudolph D., Johns Hopkins Univ., USA; Noesie, Erick, Johns Hopkins Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 364-366; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Type II keratin 6 (K6) and type I kereatins 16 and 17 (K16 and K17) are intermediate filament(IF) proteins that are induced in wound-edge keratinocytes as early as 46 hours after injury to skin, either human or mouse. This induction occurs at the expense of the keratin proteins that are normally expressed in differentiating epidermal keratinocytes. Correlated with these changes in protein expression, keratinocytes undergo major cytoarchitectural; alterations that affect their shape, intracellular organization, surface morphology and adhesion properties. We recently proposed that the intrinsic properties of K16 are compatible with a direct role in keratinocyte activation at the wound edge. Unlike K14 we found that K16 forms unstable heterotetramer subunits that polymerize into shorter filaments when paired with a variety of type II keratin partners. The main objective of this study was to determine the biochemical basis of the unique tetramer-forming properties of K16 as a first step toward a full understanding of its significance in the regulationand function of this keratin.

Derived from text

Biochemistry; Cells (Biology); Epidermis; Injuries; Morphology; Proteins; Cytology; Wound Healing; Cytoplasm

19990054499 National Inst. of Arthritis and Musculoskeletal and Skin Diseases, Bethesda, MD USA

Structural-Mechanical Integration of Keratin Intermediate Filaments With Cell Peripheral Structures in the Cornified Epidermal Keratinocyte

Steinert, Peter M., National Inst. of Arthritis and Musculoskeletal and Skin Diseases, USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 367-370; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The outermost visible layer of the skin consists of terminally differentiated, flattened, dead, cornified cells (squames). These squames consist predominantly of keratin intermediate filaments (KIF) embedded in a matrix of filaggrin, and these are contained within a specialized thickened insoluble cell peripheral structure termed the cornified cell envelope (CE). The primary function fo these cells is to provide a barrier against the environment. We are interested in how these components are assembled and integrated, since it now seems that any defect in either component will cause a serious epidermal disorder, generally and ichthyosiform disease.

Derived from text

Cells (Biology); Keratins; Mechanical Properties; Skin (Anatomy); Epidermis

19990054500 Northwestern Univ., Cell and Molecular Biology, Chicago, IL USA

What Links Laminin-5 to the Keratin Cytoskeleton in Epithelial Cells?

Jones, Jonathan C. R., Northwestern Univ., USA; Skalli, Omar, Northwestern Univ., USA; Goldman, Robert D., Northwestern

Univ., USA; Baker, Scott E., Northwestern Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 371-373; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The extracellular matrix plays an important role in tissue morphogensesis. It does so, in part, by interacting with a family of heterodimeric cell surface receptors called integrins. The integrins are considered to play an important role, not only in adhesion of cells to matrix, but also in signal transduction between the matrix and the cells. Signal transduction via integrins involves the cytoskeleton and cytoskeleton -associated proteins which bind to the cytoplasmic domain of the integrin subunits. Our particular interest in in the alpha6-beta4 integrin heterodimer. This integrin is unusual because it is involved in keratin intermediate filament (IF)/cell surface anchorage at the site of hemidesmosomes -structures that play an important role in epithelial cell-matrix linkage.
Derived from text

Adhesion; Cytoplasm; Keratins; Proteins; Cells (Biology); Cytology; Epithelium

19990054501 Northwestern Univ., Dept. of Pathology, Chicago, IL USA

Desmosomes: Integrators of Mechanical Integrity in Tissues

Green, Kathleen J., Northwestern Univ., USA; Kowalczyk, Andrew P., Northwestern Univ., USA; Bornslaeger, Elayne A., Northwestern Univ., USA; Palka, Helena L., Northwestern Univ., USA; Norvell, Suzanne M., Northwestern Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 374-377; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The most prominent cell surface attachment site for intermediate filaments at epithelial cell-cell interfaces is the desmosome. This paper summarizes the research into the protein-protein interactions required for the assembly of a normal desmosome and for anchoring Intermediate Filaments to the desmosomal plaque.
Derived from text

Anchors (Fasteners); Proteins; Cells (Biology); Cytology; Epithelium; Adhesion

19990054502 Cincinnati Univ., Dept. of Cell Biology, OH USA

Protein-Protein Interactions in Intermediate Filament Structure and Anchorage to the Cell Surface

Meng, Jin-Jun, Cincinnati Univ., USA; Bornslaeger, Elayne, Northwestern Univ., USA; Green, Kathleen J., Northwestern Univ., USA; Ip, Wallace, Cincinnati Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 378-380; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Many biological processes involve dramatic changes in cellular morphology. These changes are attributable, to dynamic remodeling that occurs as a result of interactions between the plasma network and the underpinning filamentous cytoskeleton. How the plasma membrane interacts with actin-containing microfilaments has been studied extensively, but considerably less is known about how it interacts with the other two classes of cytoskeletal elements - microtubules and intermediate filaments (IFs). Understanding how IFs are built and how the interact with the cell surface has been a focus of our laboratories for the past several years. This research has begun to reveal interesting information as to how IFs are constructed, and how they interact with other cytoplasmic components to bring about mechanical stabilization of cells and tissues. They also raise the possibility that although IFs are believed to serve primarily a structural function in all tissues in which they are found, the underlying molecular basis for each case may be different. Identifying such differences should bring new insights to the larger problem of tissues formation and maintenance.
Derived from text

Membranes; Microfibers; Proteins; Anchors (Fasteners); Cells (Biology); Cytology

19990054503 Wien Univ., Inst. of Biochemistry and Molecular Cell Biology, Austria

Domain Structure and Transcript Diversity of Plectin

Wiche, Gerhard, Wien Univ., Austria; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 381-383; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Plectin, a cytoskeleton-associate protein of exceptionally large size, is abundantly expressed in a wide variety of mammalian tissues and cell types. It is codistributed with different types of intermediate filaments and is prominently located at the plasma membrane attachment sittes of IF's and of microfilaments such as hemidesmosomes, z-line structures and dense plaques of striated and smooth muscle, intercalated discs of cardiac muscle, and focal contacts. Furthermore, in several tissues including brain and kidney, plectin expression is prominent in cells forming tissue layers at the interface of tissue and fluid-filled cavities. These observations are consistent with a model in which the role of plectin is to strengthen cells against mechanical stress both along their surfaces, and at their internal anchorage sites for cytoskeletal filaments. The findings discussed in this paper, lend support

to the hypothesis that plectin is a versatile organizing element of the cytoskeleton and they provide insights into a complex gene regulatory machinery.
Derived from text
Proteins; Cytoplasm; Cytology; Protoplasm; Cells (Biology); Binding

19990054504 National Cardiovascular Center Research Inst., Dept. of Structural Analysis, Suita City, Japan
Response of Vascular Endothelial Cells to Fluid Flow
Fujiwara, Keigi, National Cardiovascular Center Research Inst., Japan; Masuda, Michitaka, National Cardiovascular Center Research Inst., Japan; Osawa, Masaki, National Cardiovascular Center Research Inst., Japan; Katoh, Kazuo, National Cardiovascular Center Research Inst., Japan; Kano, Yumiko, National Cardiovascular Center Research Inst., Japan; Harada, Noboru, National Cardiovascular Center Research Inst., Japan; Lopes, Rosangela B., National Cardiovascular Center Research Inst., Japan; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 384-386; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Fluid flow triggers a variety of responses in vascular endothelial cells (ECs), such as initiation of signal transduction, modulation of gene expression, and remodeling of cytoskeletal and related structures. However, the primary steps of mecahanosensing are not known. Because fluid flow is a mechanical stimulus, we decided to study how ECs respond in a vectorial manner. Among the various types of responses those involving the cytoskeleton are clearly vectorial. Using a parallel plane flow chamber mounted on a light microscope, we first analyzed morphological responses of EC's to laminar flow. We found that, in addition to the already is known morphological responses to flow, flow induced preferenital development of lamellipodia in the direction of flow. This latter response caused ECs to migrate preferentially in the flow direction. Our immunofluorescence and electron microscope studies show that both apical stress fibers and apical plaques are present in ECs in situ.
Derived from text
Gene Expression; Laminar Flow; Morphology; Parallel Flow; Endothelium; Cells (Biology); Cytology

19990054505 Virginia Univ., Dept. of Cell Biology, Charlottesville, VA USA
A Role for pp125(sup FAK) in Suppression of Apoptosis in Fibroblasts
Otey, Carol A., Virginia Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 387-389; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Integrins are the transmembrane receptors that serve to anchor the cell to the extracellular matrix. Integrins are found clustered in specialized membrane domains called focal adhesions. In addition to cell-to-matrix adhesion , a number of functions have been attributed to focal adhesions, including anchorage of the actin cytoskeleton to the membrane and bi-directional signal transduction across the membrane. The data support the following model: normal cells bind to the extracellular matrix through integrins which results in the activation of pp125-FAK, a tyrosine kinase, which then signals the nucleus to suppress apoptosis. Tumorigenic cancer cells posses higher levels of active FAK, which suppresses apoptosis regardless of cell attachment and permits the cells to survive and grow in a suspension.
Derived from text
Cancer; Fibroblasts; Membranes; Cells (Biology); Cytology; Adhesion

19990054506 California Univ., San Diego, Dept. of Bioengineering, La Jolla, CA USA
Effects of Hemodynamic Forces on Gene Expression and Signal Transduction in Endothelial Cells
Chien, Shu, California Univ., San Diego, USA; Shyy, John Y. J., California Univ., San Diego, USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 390-393; In English; See also 19990054485
Contract(s)/Grant(s): NIH-HL-44147; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Vascular endothelial cells respond to mechanical forces, such as shear stress, by expressing a number of immediate early genes. One of these genes encodes monocyte chemotactic protein-1 (MCP-1), which plays a significant role in atherogenesis. This presentation summarizes the work done on the effects of shear stress on signal transduction and on the expression of the MCP-1 gene.
Derived from text
Cardiovascular System; Hemodynamic Responses; Proteins; Shear Stress; Endothelium; Cells (Biology); Cytology; Gene Expression

19990054507 NASA Johnson Space Center, Houston, TX USA

Effect of Flow on Gene Regulation in Smooth Muscle Cells and Macromolecular Transport Across Endothelial Cell Monolayers

McIntire, Larry V., Rice Univ., USA; Wagner, John E., Rice Univ., USA; Papadaki, Maria, Rice Univ., USA; Whitson, Peggy A., NASA Johnson Space Center, USA; Eskin, Suzanne G., Texas Biotechnology Corp., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 394-399; In English; See also 19990054485; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Endothelial cells line all of the vessels of the circulatory system, providing a non-thrombogenic conduit for blood flow; they regulate many complex functions in the vasculature, such as coagulation, fibrinolysis, platelet aggregation, vessel tone and growth, and leukocyte traffic; and they form the principal barrier to transport of substances between the blood and the surrounding tissue space. The permeability of endothelial cell changes with environmental stimuli; shear stress, in particular, applied either in vivo, or in vitro, induces changes in protein expression and secretion of vasoactive factors by endothelial cells. The ability to study the effects of shear on the macromolecular permeability of the cerebral vasculature is particularly important, since in no other place is the barrier function of the endothelium more important than in the brain. The endothelial cells of this organ have developed special barrier properties that keep the cerebral system from experiencing any drastic change in composition; together with glial cells, they form the blood brain barrier (BBB). We have studied the effect of flow on bovine BBB using flow chambers and tissue culture systems.

Author

Blood Flow; Brain; Cerebrum; Circulatory System; Endothelium; Proteins; Shear Stress; Tissues (Biology); Muscles; Cells (Biology); Cytology

19990054508 Northwestern Univ., Dept. of Cell and Molecular Biology, Chicago, IL USA

Identification of a Functional Domain in Laminin-5

Baker, Scott E., Northwestern Univ., USA; Jones, Jonathan C. R., Northwestern Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 400-401; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Laminin-5, a trimer composed of Alpha3, Beta3 and Gamma3 subunits, is an important component of epithelial basement membranes, and is spatially associated with cell-substrate adhesion structures called hemidesmosomes. Hemidesmosomes are associated with keratin filaments and are therefore considered linkers of the extracellular matrix and the intermediate filament cytoskeleton. The results of the research indicate that the globular, G domain, of laminin-5 appears to be essential for both epithelial cell interaction and nucleation of hemidesmosome assembly. This conclusion is consistent with studies of laminin-1 whose G domain has also been shown to mediate a number of important processes. Our study provides the first direct evidence that the G domain of Laminin-5 is not only an structural component of the extracellular matrix-cytoskeleton link, but also a crucial player in its formation.

Derived from text

Adhesion; Keratins; Trimers; Cytology; Cells (Biology); Cell Membranes (Biology)

19990054509 Harvard-MIT Div. of Health Sciences and Technology, Cambridge, MA USA

Interaction of Vimentin With Actin and Phospholipids

Shah, Jagesh V., Harvard-MIT Div. of Health Sciences and Technology, USA; Wang, Louise Z., Brigham and Women's Hospital, USA; Traub, Peter, Max-Planck-Inst. for Cell Biology, Germany; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 402-405; In English; See also 19990054485

Contract(s)/Grant(s): NIH-AR-38910; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Vimentin intermediate filaments are a major cytoskeletal constituent of cells of mesenchymal origin. They have been colocalized with a variety of intracellular structures such as actin filament and the plasma membrane. Labeled actin filaments, observed in vitro by fluorescence microscopy, break in the presence of polymerizing vimentin; the time course is consistent with stopped-flow measurements of vimentin polymerization. This breakage phenomenon appears to be specific for vimentin. Inhibition of vimentin network formation was observed with phosphatidyl inositol phosphate (PI(4)P) and phosphatidyl inositol bisphosphate (pi(4,5)p2) but not phosphatidyl choline (PC), phosphatidyl serine (PS) or phosphatidyl inositol (PI). Taken together, these results indicate a specific interaction of vimentin with F-actin and polyphosphoinositide lipids.

Author

Inositols; Phosphates; Polymerization; Cytology; Cells (Biology)

19990054510 Brigham and Women's Hospital, Boston, MA USA

Two Distinct Mechanisms of Actin Bundle Formation

Tang, Jay X., Brigham and Women's Hospital, USA; Janmey, Paul A., Brigham and Women's Hospital, USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 406-408; In English; See also 19990054485; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Actin filaments (F-actin), one of the major types of cytoskeletal filaments, can be induced to form bundles by the addition of a number of polycations, including divalent metal ions, trivalent hexaminecobalt, or basic polypeptides. The general features of bundle formation, as detected by light scattering, centrifugation, optical and electron microscopy, are largely independent of the specific structure of the bundling agent used. The formation of lateral aggregates of actin filaments in response to polycations begins at threshold concentration that varies strongly with the valence of the cation and increases with the ionic strength of the solution. Polyanions, such as nucleoside phospates and acidic polypeptides, disperse actin bundles into single filaments. Derived from text

Cations; Polypeptides; Valence; Bundles; Aggregates; Cells (Biology); Anions; Cytology

19990054511 Wisconsin Univ., Lab. of Molecular Biology, Madison, WI USA

Plectin Sidearms Mediate Interactions of Intermediate Filaments With Microtubules and Other Components of the Cytoskeleton

Svitkina, Tatyana M., Wisconsin Univ., USA; Verkhovsky, Alexander B., Wisconsin Univ., USA; Borisy, Gary B., Wisconsin Univ., USA; The Cytoskeleton: Mechanical, Physical, and Biological Interactions; 1996, pp. 409-410; In English; See also 19990054485; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The results presented in this paper provide direct structural evidence of the hypothesis that Intermediate Filament (IF)-plectin complexes comprise an extensive cross-linking of cellular components and provide a structural framework for the integration of cytoplasm. In this model, IFs provide the core while plectin forms peripheral linkers that connect to Microtubules (MTs), the actin-based cytoskeleton and membrane structures. However, IFs and plectin do not seem to be equal partners in performing their functions. The absence of obvious phenotype in Vimentin-null mice suggests that vimentin's role in cytoplasmic organization is not essential. In contrast, plectin seems to play a key role in maintaining tissue integrity, as has been demonstrated by analysis of human hereditary disorder showing plectin deficiency. Though plectin prefers to associate with IFs it can cross-link cytoskeletal structures in the absence of vimentin. Consequently, plectin may be able to maintain cytoplasmic integrity independently of IFs. Derived from text

Cytoplasm; Membrane Structures; Cells (Biology); Cytology; Proteins

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

19990053568 Army Aeromedical Research Lab., Fort Rucker, AL USA

A Survey of Work and Sleep Hours of US Army Aviation Personnel ***Final Report***

Caldwell, J. L.; Gilreath, Steven R.; Norman, David N.; Apr. 1999; 35p; In English

Contract(s)/Grant(s): Proj-30162787A878

Report No.(s): AD-A362964; USAARL-99-16; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this survey was to determine when Army aviation personnel work and sleep while on reverse cycle. A total of 157 aviation personnel from 3 Army posts were sampled. The one-page questionnaire indicated that the majority of aviation personnel had experience working night shift/reverse cycle at some point in their careers; however, over one third had not dealt with this shift for more than 3 years. Usually the night shift occurred from early in the afternoon to early in the morning, with aviators arriving home after 0800. However, a large group of responders returned home from the night shift by 0400. Although most of the responders indicated they were able to sleep after a night shift for at least 7 hours, many of them indicated they did not feel they received adequate daytime sleep most or some of the time. Although many aviators reported returning home by 0400, there is a large percentage who indicated they did not return home until after 0800, making it difficult to obtain adequate sleep. These results indicate that research is needed to address the issue of helping aviation personnel sleep during the daylight hours, both for training exercises and for deployment. Techniques for adjusting to night shift should emphasize enhanced alertness during the night with high performance and improved safety, as well as restful sleep during the day. Once the work/rest schedule for a

unit is known, countermeasures to address adjustment to reversed sleep/wake cycles can be tailored to the specific needs of the individual or unit.
DTIC
Sleep; Aircraft Pilots; Aerospace Medicine; Biological Effects; Flying Personnel; Sleep Deprivation

19990053572 NASA Langley Research Center, Hampton, VA USA
Aerospace Medicine and Biology: A Continuing Bibliography with Indexes, Supplement 495
Jul. 12, 1999; 31p; In English
Report No.(s): NASA/SP-1999-7011/SUPPL495; NAS 1.21:7011/SUPPL495; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report lists reports, articles and other documents recently announced in the NASA STI Database.
Author
Aerospace Medicine; Data Bases; Biology

19990053578 Army Aeromedical Research Lab., Fort Rucker, AL USA
Evaluating Performance Effects of a Medication (Dexedrine) in the Simulator Versus Aircraft Environment ***Final Report***
Caldwell, John A.; Roberts, Kristi A.; Jones, Heber D.; Apr. 1999; 20p; In English
Contract(s)/Grant(s): Proj-30162787A879
Report No.(s): AD-A362972; USAARL-99-15; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
A quasi-experimental approach assessed the pilot performance comparability of simulator versus in-flight results. Flight data from three sleep-deprivation studies were pooled. Twenty aviators were included, 10 who flew a UH-60 helicopter simulator and 10 who flew a UH-60A aircraft under the influence of Dexedrine or placebo during 40 hours of continuous wakefulness. Performance on straight and levels, right and left turns, climbs and descents, and a left-descending turn (assessed at 0100, 0500, 0900, 1300, and 1700) tended to correspond in the simulator and aircraft. Generally, performance under Dexedrine was better than under placebo. However, only half of the maneuvers showed consistent, statistically significant stimulant/fatigue effects in both flight platforms. Measurement sensitivity was lower in the aircraft, likely because of error variance due to environmental influences (weather, temperature, and turbulence) and other factors (radio traffic and anxieties about safety). Thus, actual in-flight studies, while desirable in terms of face-validity, underestimate the impact of stressors such as fatigue on pilots.
DTIC
Aerospace Medicine; Pilot Performance; Simulators; Flight Simulation; Biological Effects

19990053786 Hospital of the Univ. of Pennsylvania, Dept. of Neurosurgery, Philadelphia, PA USA
Concussive Effects of Low Frequency Sound Exposure ***Final Report, 1 Jul. 1997 - 31 Mar. 1999***
McIntosh, Tracy K., Hospital of the Univ. of Pennsylvania, USA; Ritting, Andrew N., Hospital of the Univ. of Pennsylvania, USA; Saatman, Kathryn E., Hospital of the Univ. of Pennsylvania, USA; Hoshino, Shigeru, Hospital of the Univ. of Pennsylvania, USA; Russ, Andrew B., Hospital of the Univ. of Pennsylvania, USA; Mar. 31, 1999; 5p; In English
Contract(s)/Grant(s): N00014-97-1-0954
Report No.(s): AD-A362965; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
We evaluated the threshold for concussive effects of low frequency underwater sound (LFS) exposure. In study 1, anesthetized (sodium pentobarbital 25mg/kg) male Sprague Dawley rats (n=96) were cannulated, ventilated (1.5% isoflurane), submerged, and exposed to 5 min. of LFS using a G40 calibrator. No alteration in cardiovascular function (arterial blood pH, p02, PC02, HR, or MABP) was observed during submersion. In study 2, animals were evaluated for two weeks following LFS exposure (150 Hz 180 dB, n=12; 250 Hz 194 dB, n=12), submersion only (n=11), or no submersion (n=11) using a battery of neurological motor tests. Cognitive function was assessed at one week using the Morris water maze (MWM). All animals were sacrificed at 15 days following for histological analysis. No effects of LFS on cardiovascular or neurological motor function were observed.
DTIC
Exposure; Underwater Acoustics; Low Frequencies; Sound Waves

19990053807 Veridian, San Antonio, TX USA
Effects of Continuous and Strobing Laser Glare on Performance in a Visually Simulated Flight Task ***Interim Report***
Beer, Jeremy; Gallaway, Robert; Jan. 1999; 19p; In English
Contract(s)/Grant(s): F41624-97-D-9000; AF Proj. 2313
Report No.(s): AD-A361767; AFRL-HE-BR-TR-1998-0125; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Strobing laser glare may present a threat to aircrew. In addition to obscuring the visibility of instruments and terrain (as continuous exposures can), strobing exposures could potentially impede visual motion processing. This report describes a study in which a low cost, medium-fidelity virtual cockpit environment was used to measure the effects of strobing vs. continuous laser exposure on performance in a visual flight task. Results suggest that strobing laser glare poses a legitimate threat to visual orientation control, that this threat might rival or eclipse that posed by continuous laser sources, and that further examination of the threat is needed.
DTIC
Eye (Anatomy); Eye Protection; Safety

53
BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

19990053658 Naval Postgraduate School, Monterey, CA USA
Evaluation of Operator Performance Using True Color and Artificial Color in Natural Scene Perception
Vargo, John T.; Mar. 1999; 137p; In English
Report No.(s): AD-A363036; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Currently, the two most commonly used night optical devices employed in military operations are the long-wave infrared sensor and the image intensified sensor. Recent advances in technology have permitted the fusion of the output of these two devices into a single color display that potentially combines the capabilities of both sensors while overcoming their limitations. Although the concept is appealing, previous sensor fusion studies have been inconclusive on the benefits of an artificially colored target. Perhaps, an artificially colored target disrupts an operator's visual processing thereby hindering the detection of a target. The purpose of this thesis is to compare the effects of artificial color, natural color, and monochrome formats in visual scene perception. It is hypothesized that participant response times and error rates would be greater at detecting an artificially colored target compared to a natural colored or a target presented achromatically. Two experiments were conducted. Experiment 1 used non-degraded imagery and Experiment 2 used degraded imagery to compare these effects. It was found that reaction time and error rates for naturally colored and achromatic images were similar and substantially less when compared to artificially colored images. For degraded scenes, natural color was more beneficial when compared to achromatic and artificially colored scenes. Additionally, artificially colored scenes caused extremely large error rates and reaction times. These results will provide algorithm developers insight into the importance of color constancy.
DTIC
Operator Performance; Color; Visual Perception; Color Vision

54
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also 16 Space Transportation.

19990053526 Defence Evaluation Research Agency, Flight Dynamics and Simulation Dept., Bedford, UK
Wavelet Analysis of Pilot Workload in Helicopter Low-Level Flying Tasks
Jones, J. G., Defence Evaluation Research Agency, UK; Padfield, G. D., Defence Evaluation Research Agency, UK; Charlton, M. T., Defence Evaluation Research Agency, UK; The Aeronautical Journal; January 1999; Volume 103, No. 1019, pp. 55-63; In English; See also 19990053521
Report No.(s): Paper-2383; Copyright; Avail: Issuing Activity (The Royal Aeronautical Society, 4 Hamilton Place, London WIV 0BQ, UK), Hardcopy, Microfiche

As part of a programme of research to improve mission effectiveness by studying pilot workload and task performance in mission-oriented flight tasks, a methodology has been developed in which wavelet analysis is used to extract information from records of vehicle response and of pilot control activity. By decomposing the records into discrete wavelets, components of vehicle agility and pilot workload are derived in the form of wavelet-based 'quickness' parameters for vehicle agility and go-called 'attack' parameters for pilot workload. It is shown how individual wavelet components in the records of pilot control activity, referred to as 'worklets', can be associated with the sub-tasks of 'guidance' and 'stabilisation'. It is demonstrated how these concepts can be applied to quantify changes in pilot control activity associated with increasing task difficulty or changes in aircraft

handling qualities. Two examples are presented, one from a flight trial in which the task difficulty was increased by changes in a prescribed ground track and the other from a simulation trial in which an increased time delay was introduced into the response of the flight control system.
Author
Wavelet Analysis; Pilot Performance; Workloads (Psychophysiology); Flight Control; Flight Characteristics

19990053791 Pacific Science and Engineering Group, Inc., San Diego, CA USA
Use of Perspective View Displays for Operational Tasks ***Final Report, May - Dec. 1998***
SaintJohn, M., Pacific Science and Engineering Group, Inc., USA; Cowen, M. B., Space and Naval Warfare Systems Command, USA; Mar. 1999; 25p; In English; Prepared in collaboration with SSC San Diego, San Diego CA.
Contract(s)/Grant(s): N66001-96-D-0048
Report No.(s): AD-A362590; TR-1795; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Research on when and how to use three-dimensional (3-D) perspective views on flat screens for military operational tasks such as air traffic control is confusing and contradictory. This report considers the basic qualities and capabilities of two-dimensional (2-D) and 3-D views. Two experiments were conducted. Because perspective views integrate all the dimensions, it was hypothesized that 3-D views are better for object understanding. In contrast, it was hypothesized that 2-D views are better for judging the relative position of objects because each dimension can be isolated. Participants viewed simple block shapes in 2-D or 3-D and either performed an object understanding task (e.g., identification, mental rotation) or a relative position task (e.g., directions and distances between objects). This report concludes that a 3-D perspective view was far superior to 2-D views for understanding the shape of the simple blocks, but 2-D views were better than 3-D views for comprehending the relative position of two objects.
DTIC
Man Machine Systems; Decision Support Systems; Decision Making; Command and Control; Communication

19990054162 Department of the Navy, Washington, DC USA
Non-Slip Safety Glasses
Moody, Paul E., Inventor; Dec. 21, 1998; 19p; In English
Patent Info.: Filed 21 Dec. 1998; US-Patent-Appl-SN-09,226,621
Report No.(s): AD-D019341; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

A side piece for eye glasses includes a front side piece portion and a rear side piece portion. The front side piece portion includes a forward end and a rearward end with an elongated, open-ended slot formed therein. The open end of the elongated open-ended slot is directed to the rearward end of the front side piece portion. The rear side piece portion includes a forward end and a rearward end with an elongated, closed-ended slot formed therein. The rear side piece portion is additionally formed of a spring metal. A stop pin is inserted through the longitudinal slot of the rear side piece portion and fixed to the front side piece portion adjacent the rear end thereof. The rear side piece portion is slidably inserted into the open-ended longitudinal slot of the front side piece portion to a point defined by contact of the stop pin with one end of the closed-end longitudinal slot, and slidably removed from the open-ended longitudinal slot to a point defined by contact of said stop pin with the remaining end of the closed-end longitudinal slot. Extension of the rear side piece portion enables automatic bending of the spring metal forming the rear side piece portion.
DTIC
Metal Working; Safety

19990054651 Illinois Univ., Dept. of Psychology, Urbana, IL USA
Effect of Reliability on Cue Effectiveness and Display Signaling
Merlo, James Louis, Illinois Univ., USA; Wickens, Christopher D., Illinois Univ., USA; May 07, 1999; 84p; In English
Report No.(s): AD-A363440; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Twenty Army personnel using either a hand-held display (HHD) or a helmet-mounted display (HMD) were asked to detect, identify, and give heading information for targets hidden in the far domain while performing a monitoring task in the near domain. Both displays had target cueing present for half of the trials, with the precision of the target cues varied across blocks. While all of the experimental blocks contained some trials with attentional cueing that was extremely accurate, placing the transparent cueing symbology on top of the target, some of the blocks had trials that also contained cues with degraded precision cueing, the cueing symbology located up to 22.5 degrees from the target center, or poor precision cueing, the cueing symbology located up to 45 degrees in visual angle from the target center. Explicit display of the precision reliability of the cues was attempted in order to help subjects diffuse attention during trials that lacked extremely accurate precision in cueing. During the last experimental

block the automated target cueing catastrophically fails, causing users to experience costs with overtrust in automation, and then costs associated with undertrust in the automation for subsequent trials. Analysis of the results were conducted looking at two specific costs of attentional cueing that we define as type A (attention) costs and type T (tmst) costs. Results show that spatially accurate cued targets were found faster than uncued targets. Targets were always found fastest on average under the cued condition while using an HMD, however, when targets are uncued the salience of the different target types caused differences in the detection rate between the display platforms suggesting a scan/clutter tradeoff between HMDs and HHDs. Attention cueing induced a type A (attention) cost, shown by the low detection rate of a higher priority but uncued target when it was simultaneously presented with a lower priority cued target.
DTIC
Helmet Mounted Displays; Display Devices; Cues

59
MATHEMATICAL AND COMPUTER SCIENCES (GENERAL

19990053812 Lawrence Livermore National Lab., Livermore, CA USA
PVODE and KINSOL: parallel software for differential and nonlinear systems
Hindmarsh, A. C.; Taylor, A. G.; Feb. 01, 1998; 24p; In English
Report No.(s): DE98-054153; UCRL-ID-129739; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this project, parallel general-purpose software for two classes of mathematical problems has been developed. PVODE is a portable solver for ordinary differential equation systems, based on robust mathematical algorithms, and targeted at large systems on parallel machines. It is the parallel extension of the earlier sequential solver CVODE. A related solver called KINSOL has been developed for systems of nonlinear algebraic equations. KINSOL was first developed as a sequential solver, on a design that permitted extending it to a parallel version with fairly minimal additions. Both PVODE and KINSOL are being used within a parallel version of the tokamak edge plasma model UEDGE. KINSOL is also being applied in the ParFlow groundwater flow model to solve a nonlinear pressure equation.
NTIS
Applications Programs (Computers); Differential Equations; Nonlinear Equations; Algebra

19990053834 Geophysical Observatory, Helsinki, Finland
Annals of the Finnish Academy of Sciences: Mathematics, Volume 23 ***Annales Academiae Scientiarum Fennicae: Mathematica, Volumen 23***
Lehto, Olli, Editor, Helsinki Univ., Finland; 1998; ISSN 1239-629X; In English; See also 19990053835 through 19990053849; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

Topics of this compilation of work include: Mapping Properties of Fatou Components; A Fundamental Domain for the Modular Group of Riemann Surfaces of Type (0,n); Quasiconformal Mappings Preserving Interpolating Sequences; Discrete Groups and Thin Sets; Interation, Level Sets and Zeros of Derivatives of Meromorphic Functions; Spaces of Geometrically Finite Representations; Elder Siblings and the Taming of Hyperbolic 3-Manifolds; Solutions of Nonhomogeneous Linear Differential Equations with Exceptionally Few Zeros; A Generalization of the Schwarzian via Clifford Numbers; Bloch Space on the Unit Ball of C(sup n); Point Shift Differentials amd Extremal Quasiconformal Mappings; Initial Limits of Temperatures on Arbitrary Open Sets; Conjugations on Rotation Domains as Limit Functions of the Geometric Means of the Iterates; Quasiconformality and Quasisymmetry in Metric Measure Spaces; and Second Order Obstacle Problems for Vectorial Functions and Integrands with Subquadratic Growth.
CASI
Mathematics; Papers

19990054540 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette France
Pu(2) Monopoles and a Conjecture of Marino, Moore and Peradze
Feehan, P. M. N.; Kronheimer, P. B.; Leness, T. G.; Mrowka, T. S.; Jan. 1999; 20p; In English
Report No.(s): PB99-148686; IHES/M/99/06; No Copyright; Avail: National Technical Information Service (NTIS), Microfiche

The purpose of this note is to show that some of the recent results of Marino, Moore, and Peradze (18), (17) can be understood in a simple and direct way via a mechanism pointed out in (7), (4), using the PU(2)-monopole cobordism of Pidstrigach and Tyurin (21).
NTIS
Monopoles; Mathematics

60
COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing. For components see 33 Electronics and Electrical Engineering.

19990053830 Communications Research Lab., Tokyo, Japan
Toward the Computer That can Talk with Humans: Research on the Mechanism of the Dialogue
Ito, Akira, Communications Research Lab., Japan; Yano, Hiroyuki, Communications Research Lab., Japan; Kumamoto, Tadahiko, Communications Research Lab., Japan; Kozima, Hideki, Communications Research Lab., Japan; Ebina, Tsuyoshi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 677-690; In Japanese; See also 19990053822; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

What is an essence of a dialogue? What is an essential constituent for the ability to ”Talk”? We report our effort toward the understanding of, and realization in the computer of, the mechanism of dialogues. The topics we attacked include: Development of E-mail user support system through dialogue, analysis of dialogues at collaborative tasks, the dialogue understanding based on the Theory of Mind, the interaction strategy for autonomous agents, and metrization of meaning and context. We tried to explore, through the research on these various topics, how people communicate at the level of intentions.
Author
Research; Man Machine Systems

61
COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

19990053574 Defence Science and Technology Organisation, Electronics and Surveillance Research Lab., Salisbury, Australia
A Primer of CORBA: A Framework for Distributed Applications in Defence
Au, T. A., Defence Science and Technology Organisation, Australia; Mar. 1999; 58p; In English
Report No.(s): AD-A362761; DSTO-GD-0192; DODA-AR-01-622; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Based on object technology, the OMG defines an Object Management Architecture (OMA) for the support of interoperable applications across heterogeneous computing platforms. The communication core of this underlying model is the Common Object Request Broker Architecture (CORBA) that provides a framework for flexible and transparent communication between distributed objects. The adoption of this approach eases software development by allowing interaction between reusable components through well-defined interfaces. In particular, applying CORBA technology to C4I problems in the military environment provides simple integration of legacy software and COTS software. This report provides an overview of the OMA, and describes in detail each component of CORBA.
DTIC
Computer Programming; Object-Oriented Programming; Software Engineering

19990053577 Air Force Research Lab., Munitions Directorate, Eglin AFB, FL USA
An Overview of the Modular Effectiveness/Vulnerability Assessment (MEVA) Architecture
Watts, David B.; Jan. 1999; 6p; In English
Report No.(s): AD-A362951; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Modular Effectiveness Vulnerability Assessment - Ground Fixed (MEVA-GF) is an engineering tool for assessing the vulnerability of fixed ground targets to conventional weapon attack. MEVA-GF is a graphical user interface (GUI) based program that provides an architecture for assembling an assessment model or simulation in modular fashion. Individual modules representing the weapon, target, weapon delivery, penetration, blast, fragmentation, etc. are linked together using a data flow paradigm that

creates the assessment network. The modularity inherent in the architecture provides the user flexibility in the design of networks by offering modules with varying levels of fidelity. MEVA-GF may be used to configure a fast running stochastic model for Monte-Carlo type calculations that require hundreds of runs for statistical accuracy. Higher fidelity models may be constructed for more deterministic type studies where longer run times are not a consideration and more precision is desired. Critical components within targets may be modeled and assigned to fault trees providing a means for assessing functional damage to a target. The targets response (i.e., damage) to the weapon effects (i.e., penetration, blast, fragmentation) is output into data files and can be visualized using a three dimensional graphical representation.
DTIC
Modules; Vulnerability; Architecture (Computers); Damage Assessment

19990053641 Naval Research Lab., Radar Analysis Branch, Washington, DC USA
Hybrid Version of Method of Moments Computer Code: IBC3D
Taylor, Douglas; May 20, 1999; 21p; In English
Report No.(s): AD-A363040; NRL/MR/5310--97-8378; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

IBC3D is a computer program used to calculate the electromagnetic scattering cross section and electric/magnetic surface currents for arbitrary three dimensional bodies coated with anisotropic lossy materials. An enhanced version of this code, developed by the Radar Division of the Naval Research Laboratory (NRL), is described here that allows one to generate a hybrid scattering solution by incorporating surface currents generated external to the IBC3D. The benefit derived from using the hybrid approach is gained by reducing the number of surface current unknowns required to produce a scattering cross section using numerically intensive computer codes such as IBC3D. When compared to the unmodified IBC3D solution for a 5-sided prism shaped object a 20 percent reduction in the number of electric surface current unknowns was obtained using the hybrid version of the code with minimal sacrifice in accuracy.
DTIC
Computer Programs; Method of Moments; Software Engineering; Coding

19990053723 Pennsylvania Univ., Dept. of Computer and Information Science, Philadelphia, PA USA
Hand Tool Manipulation and Self-Presence in VR ***Final Report, 1 Apr. 1997 - 30 Sep. 1998***
Badler, Norman I.; May 1999; 5p; In English
Contract(s)/Grant(s): N00014-97-1-0396
Report No.(s): AD-A362871; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective was to purchase Virtual Reality and associated computing equipment to enable the investigation of full body avatar control and self-presence using both fine motion hand manipulation plus force feedback as well as whole body posture and motion sensors.
DTIC
Posture; Virtual Reality; Feedback; Manipulators

19990053731 Naval Postgraduate School, Monterey, CA USA
Phsychophysical Comparisons in Image Compression Algorithms
Bodine, Christopher J.; Mar. 1999; 127p; In English
Report No.(s): AD-A362726; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Battlefield commanders are now requesting real-time visual battlefield information. These requests place an enormous strain on current transmission resources due to the file size of the images. As more and more visual information is sent, the ability to compress images efficiently becomes a significant issue. This thesis investigates whether any of the new image compression algorithms (Radiant TIN, Titan ICE, or Low Bit Rate) achieve higher compression ratios than the National Imagery Transmission Format Standard currently used by the Department of Defense. Titan ICE was found to perform better then Radiant TIN; however, the difference is not statistically significant. The Navy already has the proprietary rights to Radiant TIN. Therefore, in the absence of statistical significance, Radiant TIN is the recommended image compression algorithm for future use by the Department of Defense.
DTIC
Real Time Operation; Algorithms; Statistical Analysis; Visual Perception; Imagery

19990053739 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA
Software Acquisition Capability Maturity Model (SA-CMM) Version 1.02 ***Final Report***
Cooper, Jack; Fisher, Matthew; Sherer, S. W.; Apr. 1999; 167p; In English

Contract(s)/Grant(s): F19628-95-C-0003
Report No.(s): AD-A362667; CMU/SEI-99-TR-002; ESC*-TR-99-002; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Government and industry have the need to improve the maturity of their internal software acquisition processes. In order for organizations to make improvements, they must know the ultimate goal and what is required to achieve that goal. Additionally, progress toward achieving the goal must be measurable. A capability maturity model provides the framework needed to facilitate the desired improvement. The Software Acquisition Capability Maturity Model (SA-CMM) has been developed to provide such a framework. This new version incorporates change requests that have been received, as well as the results of lessons learned from conducting appraisals and from the use of Version 1.01.
DTIC
Software Engineering; Organizations; Industries

19990054152 Columbia Univ., Center for Telecommunications Research, New York, NY USA
Generic Management and Control API Based on an Object-Level Interaction Paradigm and Its Demonstration in a Virtual Workshop Service ***Final Report, Sep. 1995 - Feb. 1998***
Lazar, Aurel L., Columbia Univ., USA; Stadler, Rolf, Columbia Univ., USA; Adam, Constantin, Columbia Univ., USA; Aurrecoechea, Cristina, Columbia Univ., USA; Borla, Marco, Columbia Univ., USA; Mar. 1999; 199p; In English
Contract(s)/Grant(s): F30602-95-C-0015; AF Proj. 4519
Report No.(s): AD-A362912; AFRL-IF-RS-TR-1999-54; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The goal of this work was to define generic application programming interfaces (APIs) for the control and management of an ATM-based telecom environment. In our approach the APIs are defined, based on an object-level interaction paradigm, as object interfaces. We define a broadband kernel as a CORBA-based distributed programming environment that facilitates the easy creation of network services and provides mechanisms for resource allocation. The primary service provided by the broadband kernel is one-to-N one-way and-to-end connectivity with quality of service. More complex services are generated as aggregations of this and other primary services. A virtual workshop service was designed and implemented to experiment with the control and management APIs. This report puts together the building blocks of a telecom architecture: the Binding Interface Base models the resources, and the set of broadband kernel algorithms are modeled as a set of interacting objects offering their APIs to higher level services and applications. This report also presents our view on management. A model for management was developed that explains how this set of interacting objects and the services provided are managed in a consistent manner.
DTIC
Distributed Processing; Human-Computer Interface; Virtual Reality; Object-Oriented Programming; Software Engineering; Software Development Tools; Applications Programs (Computers); Programming Environments

19990054314 Naval Surface Warfare Center, Dahlgren Div., Dahlgren, VA USA
Implementation of Successful Practices Using an Iterative Development Methodology for an AEGIS Configuration Management Software Application ***Final Report***
Colston, Sharon N.; Sep. 1998; 155p; In English
Report No.(s): AD-A363072; NSWCDD/MP-98/118; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This paper documents a two-and-a-half year software development project of the Combat Systems Configuration Management Branch of the Combat Systems Department at Naval Surface Warfare Center, Dahlgren Division (NSWCDD), at Dahlgren, Virginia. The author simultaneously managed two AEGIS Configuration Control Engineering Status System (ACCESS) software development projects and pursued a master's degree in Software Engineering Technical Management through the National Technological University sponsored by NSWCDD. The paper describes lessons learned and practical experience gained by the author in managing a software development project to successful completion. The narrative includes methods that worked and ones that did not work. Critical success factors that the author considers most important to satisfactory software development are: (1) structured and documented iterative life cycle development methodology; (2) implementation of software engineering repeatable processes; (3) highly-motivated, technically experienced dedicated team; (4) continuous and substantial customer involvement; (5) self-directed, empowered management style; and (6) experienced and committed project leader.
DTIC
Software Engineering; Life (Durability); Computer Programming; Configuration Management; Engineering Management; Systems Management

19990054341 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Buy It Prototype Software Requirements Analysis: A C-BASS Component ***Final Report, Jan. - Mar. 1997***
Schallhorn, Brian R.; Jernigan, Wade S.; Ulery, Dana L.; May 1999; 58p; In English
Report No.(s): AD-A363050; ARL-MR-444; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This document contains the software requirements analysis for a prototype of BuyIt. As a component of the Corporate Business Application Software System (C-BASS), this application automates small purchase requests (under $2,500). The document follows the process of structured analysis, or stepwise refinement of requirements, as applied to the development of Buylt. The environmental model includes a high level system description, followed by a context diagram and a list of events to which the system must respond. The behavioral model includes a data flow diagram (DFD) for each of the seven BuyIt subsystems. From this representation, the basic functional specifications are derived and represented in structured English (or program design language). The final segment of the document includes a data dictionary.
DTIC
On-Line Systems; Functional Design Specifications; Computer Programming; Applications Programs (Computers)

19990054350 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
BuyIt Software Development Plan: A C-BASS Component
Ulery, Dana L.; Schallhorn, Brian R.; Jernigan, Wade S.; May 1999; 29p; In English
Report No.(s): AD-A363051; ARL-MR-443; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A critical factor in the U.S. Army Research Laboratory's (ARL) strategy to do more with less resources is the automation of a single, ARL wide purchasing process. This report describes the initial plan for developing the BuyIt Prototype, a software prototype for an automated purchasing system that provides an electronic workflow for ARL purchasing processes and interfaces with standard Department of Defense (DoD) systems required by those processes. The BuyIt Prototype is the first component of the Corporate Business Application Software System (C-BASS), a suite of integrated online transaction process software products that will provide Corporate business functions electronically throughout the ARL enterprise. C-BASS is a cornerstone of the new ARL Enterprise Information Technology Architecture developed in 1997 by the Enterprise Systems Division. This report provides a statement of the problem to be solved by the BuyIt Software, the technical and management approaches to be used, and a detailed project schedule.
DTIC
On-Line Systems; Applications Programs (Computers); Computer Programs; Software Engineering

19990054353 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
A Framework for Effective Algorithm Visualization Using Animation-Embedded Hypermedia
Hansen, Steven R.; Apr. 07, 1999; 274p; In English
Report No.(s): AD-A363104; FY99-96; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

If a "picture is worth a thousand words," then why have attempts over the past decade to use pictures and animations to replace or supplement traditional instructional methods for teaching algorithms produced such disappointing results? Numerous studies and experiments have been conducted to show that pictures and animations can improve learning of challenging, abstract concepts like mathematical proofs and the algorithms used in computer science. While the pictures and animations seem to be enthusiastically received by the students, none of the studies have produced results that show consistently and conclusively that these visual tools actually improve learning. In fact, the accumulated empirical evidence is mixed at best, and could easily lead one to abandon the premise that animations are powerful vehicles for effectively conveying the dynamic behaviors of algorithms. However, this dissertation reports on research based on the premise that a rethinking of algorithm animation design is required in order to harness its power to enhance learning. Research reported here explores the integration of previous work in algorithm animation systems with recent developments in the cognitive and educational domains to produce a new model for using software visualizations to improve student comprehension. The model is based on focused learning objectives that drive a top-down design that carefully divides abstract concepts into discrete chunks for learning. The model takes a user-centered ("what do we need to show") view rather than a designer-centered ("what can we show") view, and employs hypermedia and multimodal presentation techniques to improve learning effectiveness. The key insights are that for algorithm animations to be effective, (1) they should be introduced using interactive analogies and real-world examples that serve a priming role for subsequent learning.
DTIC
Algorithms; Software Engineering; Proving

19990054592 Atlantic Aerospace Electronics Corp., Waltham, MA USA
Dynamic Database for Sensor Fusion ***Final Report, Jul. 1997 - Jun. 1998***
Baim, Paul; May 1999; 39p; In English
Contract(s)/Grant(s): F30602-97-C-0304; AF Proj. D844
Report No.(s): AD-A363915; DFR-1401; AFRL-SN-RS-TR-1999-77; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This effort developed a prototype Dynamic Database front end using Virtual Reality Modeling Language, Object Design's Persistent Storage Engine, and custom Java code. This approach produced a self contained web browser based tool for displaying and manipulating complex information typical of anticipated products from the Dynamic Database. The result is visually appealing, compact, and runs on most platforms using readily available low or no-cost software.
DTIC
Data Bases; Virtual Reality; Java (Programming Language); Computer Programs; Internets

62
COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

19990053659 Washington Univ., Aerospace and Energetics Research Program, Seattle, WA USA
Parallel Workstation Cluster for Algorithm Development, Parameter Scoping, and Data Analysis ***Final Report, 1 Feb. 1998 - 31 Jan. 1999***
Shumlak, Uri; Apr. 26, 1999; 12p; In English
Contract(s)/Grant(s): F49620-98-1-0244
Report No.(s): AD-A363032; 62-0287; AFRL-SR-BL-TR-99-0124; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A cluster of workstations is connected with a fast network and used as a local parallel computer. This approach mimics the interprocessor communication and scalability of the large machines at a fraction of the cost. This system uses off-the-shelf hardware and public domain software, which makes the system simple to assemble and maintain. The parallel workstation cluster has already significantly contributed to our AFOSR project. The cluster accelerates the algorithm development process because it eliminates the delays associated with remote computing on shared resources. The parallel workstation cluster performs simulations to scope a parameter space for optimization and design. A parallel supercomputer is then used for the detailed scoping using fewer runs. This approach has helped to alleviate the over-subscription of the shared resources and has allowed us to obtain the computational results in less time.
DTIC
Computer Programs; Parallel Computers; Algorithms; Data Processing

19990053724 Georgia Inst. of Tech., Atlanta, GA USA
ARL Intranet Analysis and Development Study ***Final Report, 18 Sep. - 18 Dec. 1998***
Ulery, Dana L.; Apr. 1999; 42p; In English
Contract(s)/Grant(s): DAKF11-97-D-0001
Report No.(s): AD-A362869; ARL-CR-441; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We analyze the concept and practice of Intranets used in midsize and large enterprises, focusing on their use and impact within research and development (R&D) organizations. We examine the shift from the old concept of business computing to the modern concept of enterprise computing, and consider Intranets-a class of enterprise computing-relative to enterprise computing trends. by analyzing in detail some case studies selected from the literature, on-site visits, and workshop discussions, we then offer three tools to frame the critical issues and provide structure for systematically constructing strategic Intranets specific to a given organization's mission and culture. Arguing that creation of an Intranet that projects an image of a world-class organization demands no less than a world-class enterprise that is strategically enabled through information technology, we then analyze the current U.S. Army Research Laboratory (ARL) Intranet and present a three-step action plan to expedite ARL's movement toward creation of such an Intranet.
DTIC
Information Systems; Trends; Local Area Networks; Research Management

19990053734 Naval Postgraduate School, Monterey, CA USA

Security Planning for Wireless Networks: DOD Concerns

Fowler, James D.; Mar. 1999; 98p; In English

Report No.(s): AD-A362720; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

Wireless networking is a rapidly emerging technology and security must be addressed as it is incorporated into new and existing local area networks (LANs). It is important to know what unique properties of wireless LANs might amplify existing LAN vulnerabilities or introduce new ones. Wireless transmission techniques, topologies, and vendor offerings were surveyed from a security perspective. Three rating systems were developed to analyze aspects of these survey areas. These areas were then rated using these systems and graphically displayed on Kiviat drawings to show symmetric comparisons of each analysis category. Frequency hopping spread spectrum (FHSS) transmission technology, cellular topology, and the Jaguar product emerge as the best current approaches available. These results are applied to a case study that examines network wired segment replacement options, wireless segment attacks, and methods to detect an attacker. Current standards offer guidance that dictate how wireless technologies must operate, but do not relate to principles of LAN design. Our study and rating system results provide guidance for creating a network topology. The case study demonstrated that care must be taken in choosing wireless network segments. This work should help system Administrators by providing examples of good and bad choices.

DTIC

Local Area Networks; Security; Radiotelephones

19990053787 Purdue Univ., School of Electrical Engineering, West Lafayette, IN USA

Instrumentation for Research on High-Speed Optical Transmultiplexing and Coding for Optoelectronic Computer Networking ***Final Report, 1 Jun. 1997 - 31 May 1998***

Weiner, Andrew M., Purdue Univ., USA; Apr. 29, 1999; 7p; In English

Contract(s)/Grant(s): F49620-97-1-0400; AF Proj. 3484

Report No.(s): AD-A363026; AFRL-SR-BL-TR-99-0122; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Equipment purchased under this contract has been used by approximately twelve researchers (two post-docs, eight graduate students, two undergraduates) for several research activities, as summarized briefly below.

DTIC

Electro-Optics; Optical Control; Optical Equipment

19990054524 Naval Academy, Annapolis, MD USA

Development of Angular Motion, Angular Momentum, and Torque Knowledge Bases for an Intelligent Physics Tutoring System

Eason, Michael D.; Jan. 1998; 112p; In English; Accepted by the U.S. Trident Scholar Committee.

Report No.(s): AD-A359481; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This research involved the design and development of a physics knowledge base which allows an intelligent tutoring system ANDES to more effectively assist students in physics problem-solving. ANDES is a Office of Naval Research funded collaborative effort between the U.S. Naval Academy and the Learning Research and Development Center at the University of Pittsburgh. The system tutors Newtonian physics via coached problem-solving a method of teaching cognitive skills where the tutor and the student work together to solve problems. The knowledge base developed in this project provides the physics backbone for the rest of the tutoring system by generating the necessary equations and solution graphs to solve selected angular motion physics problems. These mathematical outputs are used by other ANDES components to provide help to the students in a variety of ways. In order for ANDES to be an effective tutoring system the knowledge base developed had to fulfill certain criteria. It needed to model a teacher's approach to problem-solving using planning and decision-making strategies to find the solution path efficiently. It also had to be robust enough to generate several solution paths for problems that have more than one possible solution method. Since this research was the first attempt to develop a knowledge base for the angular motion area of physics encoding these concepts presented unique challenges. For example the concept of normal force which is easily understood in the classic "object on top of a surface problem" becomes more difficult in the classic "roller coaster at the top of a loop" problem. However, both visualizations had to be modeled by the same implementation. The knowledge base designed and developed in this project successfully accomplished this modeling and is presently being incorporated into the larger ANDES project.

DTIC

Systems Engineering; Knowledge Based Systems; Torque; Angular Momentum; Angular Velocity

19990054591 Defence Science and Technology Organisation, Information Technology Div., Canberra Australia

A Preliminary Study of Open Signalling for ATM Networks

Au, T. A., Defence Science and Technology Organisation, Australia; Mar. 1999; In English

Report No.(s): AD-A363914; DSTO-TR-0800; No Copyright; Avail: Issuing Activity, Microfiche

Based on a clear separation between switching hardware and control software, the concept of open signaling creates an open programmable networking environment. Network entities can be realized as high level objects with well defined software interfaces, facilitating the creation of multiple mechanisms for connection management. Applying open signaling in defense networks can enhance the flexibility in supporting network services, allowing dynamic control of quality of service for maximum military value. This report discusses the design criteria and the associated performance issues of a connection management system for ATM networks. However, significant binding overheads are generated in remote operation invocations, adding a level of complexity to network control. This complexity is expected to diminish as middleware technology matures, thereby improving the overall performance in connection management.

DTIC

Signal Processing; Asynchronous Transfer Mode; Architecture (Computers); Network Control; Computer Networks

63
CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also 54 Man/System Technology and Life Support.

19990053573 AvXm Partnership, Kettering, OH USA

Thin Film Growth Simulation Using Cellular Automata State Space, and Neural Nets Methods ***Final Report, 21 Apr. - 1 Oct. 1998***

Jackson, A. G., AvXm Partnership, USA; Benedict, M., AvXm Partnership, USA; Feb. 1999; 35p; In English

Contract(s)/Grant(s): F33615-98-C-5138; AF Proj. 3005

Report No.(s): AD-A362754; AVXM-99-1; AFRL-ML-WP-TR-1999-4028; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this research was to demonstrate simulation of multi-species thin film growth that is fast, displays on a desktop computer, and utilizes a unique combination of cellular automata, state space, and neural nets. Software to accomplish this objective was refined by developing computer code that implements a physical model of film growth. Neural nets were into rated into the software to reduce the time needed for computing the atom positions, and generation of examples needed or training and testing the neural nets was accomplished via visual basic code. Display of the simulation using a desktop computer (Macintosh Power PC) was achieved. Functionalities for live rotation and modification the film are included, as well as the capability to record the simulation as a computer movie. Study of vacancy behavior using the simulation of about 30, believed to be a result of scaling issues in used model. This software can be used to simulate film growth for molecular beam epitaxy and pulsed laser deposition processes. Physical and chemical model studies an process refinement studies can be accomplished using this software.

DTIC

Automata Theory; Information Theory; Neural Nets; Thin Films

19990053580 Naval Postgraduate School, Monterey, CA USA

Visual Analysis of a Radio Frequency Tracking System for Virtual Environments

Campbell, Philip E.; Jun. 1999; 96p; In English

Report No.(s): AD-A363020; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A variety of position tracking technologies have been utilized for virtual environments. Each has a different set of strengths and weaknesses which are usually compared on paper with numbers or generic statements. This thesis develops a methodology for the creation of 3D visualization tools to analyze position tracking technologies and their effectiveness under specific conditions. The methodology includes developing the questions, the models, the simulations, the visualization, and the rendering. This thesis applies the methodology to Advanced Position Systems, Inc.'s RF tracking system which can be easily configured for large volume spaces, unlike any of the other technologies. The analysis asks "How does the positioning of the receivers affect the relative accuracy throughout the target volume?". The model uses the solution to the Time Difference of Arrival (TDOA) equations used by the system and the simulation evaluates the position error throughout the volume with a constant error in the TDOA measurements. Point icons represent the data and the Virtual Reality Modeling Language renders the visualization. The asymmetric

error profile revealed by this 3D visual analysis arises from the asymmetric arrangement of the TDOA measurements and is not readily apparent with other analytical techniques.
DTIC
Radio Frequencies; Virtual Reality; Tracking (Position)

19990053589 Siemens A.G., Zagreb, Croatia
Adaptive Routing Strategies Using Learning Automata ***Adaptivne Strategije Postavljanja Poti na Osnovi Ucecih se Avtomatov***
Lukac, Kresimir, Siemens A.G., Croatia; Pavicic, Hrvoje, Zagreb Univ., Croatia; Tkalic, Mladen, Zagreb Univ., Croatia; Electrotechnical Review; 1998; Volume 65, Nos. 2-3, pp. 127-132; In English; See also 19990053584; No Copyright; Avail: Issuing Activity (Elektrotehniski Vestnik, Fakulteta za Elektrotrhniko, Trzaska 25, 1001Ljubljana, Slovenia), Hardcopy, Microfiche

Modern end-to-end switching networks have forced us to reconsider the routing schemes that are used in traditional networks. The reexamination is necessary since the choice on the call's route is predefined in these networks and does not dynamically adapt itself to the environmental charges. In these paper we present and evaluate adaptive routing schemes based on the concept of the learning automata. Our concern is to get efficient routing with a better utilization of network resources as compared to traditional fixed routing schemes i.e. to provide a higher network throughput. to show the feasibility ot this routing as well to provide a base for simulating and implementing a variety of routing schemes, we have designed LAG, a tool which should help us in the network design process.
Author
Automata Theory; Switching; Networks

19990053831 Communications Research Lab., Tokyo, Japan
Research and Development on Intelligent Information Processing Based on Sensory Mechanism of Biological Organism
Sawai, Hidefumi, Communications Research Lab., Japan; Noda, Hideki, Communications Research Lab., Japan; Arakawa, Yoshiki, Communications Research Lab., Japan; Peper, Ferdinand, Communications Research Lab., Japan; Zhang, Bing, Communications Research Lab., Japan; Yamazaki, Tatsuya, Communications Research Lab., Japan; Shirazi, Mahdad N., Communications Research Lab., Japan; Maekawa, Satoshi, Communications Research Lab., Japan; Fujiwara, Yoshihisa, Communications Research Lab., Japan; Shirazi, Mehdi N., Communications Research Lab., Japan; Yanagida, Masuzo, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 691-704; In Japanese; See also 19990053822; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Using the modeling of a sensory mechanism, we have studied novel speech and image processing methods and have integrated information processing techniques contributing to an efficient use of communication channels and smooth information transmission between men and machines. This research theme has been carried out based on the following four subjects: (1) Modeling of the sensory mechanism: by applying Markov Random Field (MRF) models, we have developed an algorithm to remove noise in a 2D static image and to properly divide the field of multi-channel remote sensing images. We have also developed parallel processing for speech recognition, and for the segmentation algorithm of degraded image. (2) Artificial neural network research: We have researched the self-organization neural network simulating Principal Component Analysis (PCA) and have proposed the learning rules for PCA. We have also developed a self-organizing formation by synaptic competitive learning. (3) Research on evolutionary computation: We have developed an image reconstruction method based on an evolutionary computation adapting to changes in human facial expressions. This method could lead various applications in a dynamically changing environment. (4) Three dimensional shape modeling and visualization: We have organized a new paradigm for extended triangular and tetrahedral processing and have achieved integrated shape modeling where the efficiency of representation and processing was greatly increased.
Author
Research and Development; Algorithms; Data Processing; Human Beings; Image Reconstruction; Intelligence; Models; Principal Components Analysis; Three Dimensional Models

19990053832 Communications Research Lab., Tokyo, Japan
Research on the Engineering Realization of Advanced Intelligent Functions
Isahara, Hitoshi, Communications Research Lab., Japan; Ma, Qing, Communications Research Lab., Japan; Shirado, Tamotsu, Communications Research Lab., Japan; Ozaku, Hiromi, Communications Research Lab., Japan; Uchimoto, Kiyotaka, Communications Research Lab., Japan; Takizawa, Osamu, Communications Research Lab., Japan; Kitamura, Yasuichi, Communications Research Lab., Japan; Yanagida, Masuzo, Communications Research Lab., Japan; Sato, Naohito, Communications Research Lab., Japan; Murata, Atsushi, Communications Research Lab., Japan; Soga, Masato, Communications Research Lab., Japan; Re-

view of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 705-715; In Japanese; See also 19990053822; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Intelligent Processing Section does research on modeling human intelligent functions, such as learning, inference and emotion, in order to construct an advanced natural language processing system. For natural language understanding, we are studying methods that understand sentences successively, simulating the type of prediction made by humans, and methods that understand not only literal meanings but also implications. For natural language generation, we are studying an adaptive mechanism that selects suitable words using situations and contexts. We are developing an intelligent network news reader that retrieves the network news each user needs. Our aim is to use this to support human intellectual activities. As a basis of the above mentioned research, ongoing work in our section includes the study of knowledge, using a neural neta,ork model; the study of emotion in sounds and polite expressions; the development of linguistic data, e.g., dictionaries and corpora; and also involves cooperation with Asian countries to develop natural language processing resources, e.g., a part-of- speech tagger for Thai.

Author

Research; Natural Language Processing; Simulation; Intelligence; Human Performance

19990054316 Virginia Polytechnic Inst. and State Univ., Dept. of Computer Science, Blacksburg, VA USA

Enhancing a CAVE with Eye Tracking System for Human-Computer Interaction Research in 3D Visualization ***Final Report, 1 Mar. 1997 - 1 May 1999***

Hix, Deborah; May 03, 1999; 4p; In English

Contract(s)/Grant(s): N00014-97-1-0395

Report No.(s): AD-A363070; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The objective of this award was to purchase and install two ISCAN Inc. Eye Tracking Systems and associated equipment to create a unique set-up for research in fully immersive virtual environments (VEs), specifically a CAVE. To our knowledge, the Virginia Tech installation is the first CAVE in the world to have eye-tracking technology incorporated into it We purchased two ISCAN Inc. Eye Tracking Systems, including calibrator, headband-mounted eye imaging system, dual video monitors, line of sight scene imaging system, magnetic head tracker, and appropriate software. The Eye Tracking Systems collect three-dimensional measurements of a user's eye inside the CAVE. These measurements are performed by calculating the direction of a line called the line-of-sight, which originates from a user's eye and extends into the environment in the direction of the pupil's gaze. Intersections between the line-of-sight and visible objects in the VE are computed, and the results are stored to a log file on disk. This work has the potential to lead to strong analytical assessment methodologies for VEs (see Conclusions above) that can reduce the effort and costs of usability evaluations of VEs.

DTIC

Virtual Reality; Graphical User Interface; Human-Computer Interface; Imaging Techniques; Line of Sight

19990054351 Naval Research Lab., Advanced Information Technology Branch, Washington, DC USA

Perspective Splatting

Swann, J. E., II; Mueller, Klaus; Moller, Torsten; Shareef, Naeem; Crawfis, Roger; May 10, 1999; 41p; In English; Prepared in cooperation with Ohio State Univ., Columbus, OH.

Report No.(s): AD-A363073; NRL/MR/5580--99-8355; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Splatting is a popular direct volume rendering algorithm that was originally conceived and implemented to render orthographic projections. This paper describes an anti-aliasing extension to the basic splatting algorithm, as well as an error analysis, that make it practical to use for perspective projections. to date, splatting has not correctly rendered cases where the volume sampling rate is higher than the image sampling rate (e.g., more than one voxel maps into a pixel). This situation arises with perspective projections of volumes, as well as with orthographic projections of high-resolution volumes. The result is potentially severe spatial and temporal aliasing artifacts. Some volume ray-casting algorithms avoid these artifacts by employing reconstruction kernels which vary in width as the rays diverge. Unlike ray-casting algorithms, existing splatting algorithms do not have an equivalent mechanism for avoiding these artifacts. In this paper we propose such a mechanism, which delivers high quality splatted images and has the potential for a very efficient hardware implementation. In addition, we analyze two numerical errors that arise with splatted perspective projections of volumes, and describe the rending-time versus image-quality tradeoffs of addressing these errors.

DTIC

Image Processing; Ray Tracing; Algorithms; Image Resolution

19990054520 Maryland Univ., Dept. of Computer Science, College Park, MD USA

Exploration of Neural Process and Language Performance ***Final Report***

Reggia, James A.; Jan. 15, 1999; 3p; In English

Contract(s)/Grant(s): N00014-97-1-0415

Report No.(s): AD-A359496; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Under this ROPO grant, Dr. Reggia provided a unique opportunity to participate with his graduate team who are studying various aspects of recovery of function using computational neural models. The stimulating environment provided many opportunities to find out about new approaches in studying brain processing. Further participation in attending related meetings, the Academy of Aphasia and both meetings organized by Dr. Reggia at the University, 1995 and 1998, Neural Modeling of Cognitive and Brain Disorders, provided bridges to the broader research community. Three graduate students were trained in LISP while re-implementing the HOPE model. Difficulties with the output control restricted our ability to run experiments on it at the end. A unique opportunity to share a graduate student computationally modeling word reading enabled us to develop a model of language lateralization. The University setting provided an environment for quiet study as well as intellectual exchange in these fields.

DTIC

Mathematical Models; Neural Nets; Words (Language)

19990054589 HURECON, Smorum, Denmark

Ecological Interface Design For Complex Systems. An Example: SEAD-UAV Systems ***Final Report, Apr. 1997 - Oct. 1998***

Rasmussen, Jens; Apr. 1998; 148p; In English

Report No.(s): AD-A363845; AFRL-HE-WP-TR-1999-0011; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This investigation evaluates a framework for design of ecological information systems as applied for the command and control function of Unmanned Aerial Vehicle (UAVs). In this context, the term interface design is not referring to the human computer interface, but to the interface between a decision maker and the deep relational structure of the workspace. This framework was developed for the domains of industrial process and manufacturing systems, tested through analyses of hospital and library systems, and recently further developed to model the socio-technical system involved in risk management in a modern, dynamic society. The introduction of uninhabited vehicles has raised considerable research interest, but the topics discussed have largely been related to the problems appearing when remote control of an air vehicle and its payload is introduced. Correspondingly, the system concept has been described as an effort to keep the pilots head in the cockpit and leave the rest of him at home and a literature search has shown that the human factors discussed are related mainly to display, control, and training issues.

DTIC

Human Factors Engineering; Pilotless Aircraft; Remotely Piloted Vehicles; Adaptive Control; Automatic Flight Control

19990054649 Nankai Junior Coll. of Technology and Commerce, Dept. of Electronics Engineering, Nantou Taiwan, Province of China

Decentralized Disturbance Attenuation for Interconnected Systems

Cheng, Cheng-Fa, Nankai Junior Coll. of Technology and Commerce, Taiwan, Province of China; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 101-108; In English

Contract(s)/Grant(s): NSC-88-2213-E-252-006; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The problem of disturbance attenuation for interconnected systems by local state feedback control is investigated. by introducing a set of parameters, one characterizing the strength of interconnections and the other scaling subsystems, necessary and sufficient conditions are obtained under which the collection of such local controllers achieves the H(sup infinity) requirement for the overall system. The H(sup infinity) performance of the closed-loop interconnected system is guaranteed and the required local state feedback control is simultaneously derived. The relationship between the H(sup infinity) control theory and the decentralized controller design under a prespecified level of disturbance attenuation is also established. This also show that a complete solution to this problem is carried out merely by solving a set of algebraic Riccati equations.

Author

H-Infinity Control; Control Theory; Controllers; Feedback Control; Control Systems Design; Systems Analysis; Design Analysis

64
NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

19990053835 Imperial Coll. of Science Technology and Medicine, Dept. of Mathematics, London, UK
Mapping Properties of Fatou Components
Herring, M. E., Imperial Coll. of Science Technology and Medicine, UK; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 263-274; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

If f(z) is meromorphic in C and N(sub 1) and N(sub 2) are components of the Fatou set of f(z) such that f(z): N(sub 1) approaches N(sub 2), it is shown that D = N(sub 2)/f(N(sub 1)) is a set which contains at most two points. If f(z) is entire then D contains at most one point. Examples show that these results are sharp and also that the points of D are general neither Picard exceptional nor Nevanlinna deficient.
Author
Meromorphic Functions; Conformal Mapping; Differential Equations; Manifolds (Mathematics)

19990053836 Suzhou Univ., Dept. of Mathematics, Suzhou, China
A Fundamental Domain for the Modular Group of Riemann Surfaces of Type (0,n)
Chen, Min, Suzhou Univ., China; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 275-281; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

In this paper we introduce the concept of extreme loop structures, and basing on it we present an explicit fundamental domain for the action of modular group in the deformation space of Riemann surfaces of genus 0 with n (n is greater than = 4) boundary components.
Author
Group Theory; Riemann Manifold; Complex Variables

19990053837 Autonoma de Barcelona Univ., Dept. de Matematiques, Barcelona, Spain
Quasiconformal Mappings Preserving Interpolating Sequences
Gonzalez, Maria J., Autonoma de Barcelona Univ., Spain; Nicolau, Artur, Autonoma de Barcelona Univ., Spain; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 283-290; In English; See also 19990053834; Sponsored in part by CIRIT
Contract(s)/Grant(s): DGICYT-PB95-0956; CIRIT-1996SRG00026; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

We consider quasiconformal mappings from the upper half plane onto itself and we show that a necessary and sufficient condition for such a mapping to preserve interpolating sequences is that its restriction to the boundary is a strongly quasisymmetric function, that is absolutely continuous with derivative an A(sub infinity) weight.
Author
Conformal Mapping; Geometry

19990053838 State Univ. of New York, Dept. of Mathematics, Stony Brook, NY USA
Discrete Groups and Thin Sets
Lundh, Torbjoern, State Univ. of New York, USA; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 291-315; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

Let GAMMA be a discrete group of Mobius transformations acting on and preserving the unit ball in R(sup d) (i.e. Fuchsian groups in the planar case). We will put a hyperbolic ball around each orbit point of the origin and refer to their union as the archipelago of GAMMA. The main topic of this paper is the question: ”How big is the archipelago of GAMMA?” We will study different ways to answer various meanings of that question using concepts from potential theory such as minimal thinness and rarefiedness in order to give connections between the theory of discrete groups and small sets in potential theory. One of the answers that will be given says that the critical exponent of GAMMA equals the Hausdorff dimension of the set on the unit sphere where the archi-

pelago of GAMMA is not minimally thin. Another answer tells us that the limit set of a geometrically finite Fuchsian group GAMMA is the set on the boundary where the archipelago of GAMMA is not rarefied.
Author
Group Theory; Potential Theory

19990053839 Illinois Univ. at Urbana-Champaign, Dept. of Mathematics, Urbana, IL USA
Iteration, Level Sets and Zeros of Derivatives of Meromorphic Functions
Hinkkanen, A., Illinois Univ. at Urbana-Champaign, USA; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 317-388; In English; See also 19990053834
Contract(s)/Grant(s): MDA904-95-H-1014; NSF DMS-94-00999; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

Let f be a meromorphic non-entire function in the plane, and suppose that for every k is greater than = 0, the derivative f(sup (k)) has only real zeros. We have proved that then f(az + b) = P(z)/Q(z) for some real numbers a and b where a is not = 0, where Q(z) = z(sup n) or Q(z) = (z(sup 2) + 1)(sup n), n is a positive integer, and P is a polynomial with only real zeros such that deg P is less than or equal to deg Q + 1; or f(az + b) = C(z - i)(sup -n) or f(az + b) = C(z - alpha)/(z - i) where alpha is real and C is a non-zero complex constant. In this paper we provide part of the proof of this theorem, by obtaining the following result. Let f be given by f(z) = g(z)/(z(sup 2) + 1)(sup n) where g is a real entire function of finite order with g(i)g(-i) not = 0 and n is a positive integer. If f, f prime, and f double prime have only real zeros then g is a polynomial of degree at most 2n + 1. Conversely, if f is of this form where g is a polynomial of degree at most 2n with only real zeros, then f(sup (k)) has only real zeros for all k is greater than = 0. If the degree of g is 2n + 1 then f(sup (k)) has only real zeros for all k is greater than = 0 if, and only if, f and f prime have only real zeros.
Author
Entire Functions; Meromorphic Functions; Theorem Proving

19990053840 Southampton Univ., Faculty of Mathematical Studies, UK
Spaces of Geometrically Finite Representations
Bowditch, Brian H., Southampton Univ., UK; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 389-414; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

We explore conditions under which the property of geometrical finiteness is open among type-preserving representations of a given group into the group of isometries of hyperbolic n-space. We give general criteria under which this is the case, for example if every maximal parabolic subgroup has rank at least n - 2. In dimension n = 3, we deduce Marden's theorem that geometrical finiteness is always an open property. We give examples to show that, in general, additional constraints of the type we describe are necessary in dimension 4 and higher.
Author
Manifolds (Mathematics); Topology; Hyperbolic Coordinates

19990053841 California Univ., San Diego, Mathematics Dept., La Jolla, CA USA
Elder Siblings and the Taming of Hyperbolic 3-Manifolds
Freedman, Michael H., California Univ., San Diego, USA; McMullen, Curtis T., California Univ., USA; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 415-428; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

A 3-manifold is tame if it is homeomorphic to the interior of a compact manifold with boundary. Marden's conjecture asserts that any hyperbolic 3-manifold M = H(sup 3)/GAMMA with pi(sub 1) finitely-generated is tame. This paper presents a criterion for tameness. We show that wildness of M is detected by large-scale knotting of orbits of GAMMA. The elder sibling property prevents knotting and implies tameness by a Morse theory argument. We also show the elder sibling property holds for all convex cocompact groups and a strict form of it characterizes such groups.
Author
Riemann Manifold; Group Theory; Hyperbolic Coordinates

19990053842 New Orleans Univ., Dept. of Mathematics, LA USA
Solutions of Nonhomogeneous Linear Differential Equations with Exceptionally Few Zeros
Gunderson, Gary G., New Orleans Univ., USA; Steinbart, Enid M., New Orleans Univ., USA; Wang, Shu-Pei, New Orleans Univ., USA; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 429-452; In English; See also

19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

We investigate equations on the form (1.1) that possess solutions which have a Borel exceptional value at zero.
Author

Differential Equations; Linear Equations

19990053843 Nara Women's Univ., Dept. of Information and Computer Sciences, Japan

A Generalization of the Schwarzian Via Clifford Numbers

Wada, Masaaki, Nara Women's Univ., Japan; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 453-460; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

A theory of the Schwarzian for sufficiently smooth local transformations of the euclidean n-space is developed using Clifford numbers. Various formulas relating the Schwarzian to Mobius transformations are given, and it is shown that the Schwarzian derivative vanishes for Mobius transformations.
Author

Euclidean Geometry; Transformations (Mathematics); Functions (Mathematics)

19990053844 Marie Curie-Sklodowska Univ., Inst. of Mathematics, Lublin, Poland

Bloch Space on the Unit Ball of C(sup n)

Nowak, Maria, Marie Curie-Sklodowska Univ., Poland; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 461-473; In English; See also 19990053834
Contract(s)/Grant(s): KBN-2-PO3A-002-08; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

In this paper we prove that fo 0 is less than p is less than infinity, the norm of a function f in the Bergman space L(sub a, sup p) on the unit ball B of C(sup n), n is greater than = 1, is equivalent to the quantity integral(sub B) (absolute value of tilda-del f(z))(sup 2).(absolute value of f(z))(sup p - 2).h(absolute value of z).dtau(z), where tilda-del and tau denote the invariant measure on B, respectively, and h(absolute value of z) = integral(sub absolute value of z, sup 1) {(1 - t(sup 2))(sup n - 1).(1 - t(sup 2n)}/t(sup 2n - 1) dt. If n is greater than 1, this result allows us to extend the characterization J(sub 2) of the Bloch space obtained to the range 0 is less than p is less than infinity, (absolute value tilda-del.f(z))(sup p) dv(z) is a Bergman-Carleson measure. finally, we get some results for spaces H(sup p) and BMOA (bounded mean oscillation), e.g. an extension of the classical Littlewood-paley inequality to the case of the unit ball.
Author

Analytic Functions; Spheres; Balls; Circles (Geometry)

19990053845 Zurich Univ., Switzerland

Point Shift Differentials and Extremal Quasiconformal Mappings

Strebel, Kurt, Zurich Univ., Switzerland; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 475-494; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

We consider quasiconformal selfmappings f of the disk with given boundary values. For fixed z(sub 0) the set of image points {f(sub 0)(z(sub 0))} for all extremal mappings f(sub 0) is called the variability set V[z(sub 0)] of z(sub 0). Extremal mappings f(sub m) which take z(sub 0) into points w(sub m) not a member of V[z(sub 0)] are called point shift mappings. They are Teichmuller mappings associated with quadratic differentials phi(sub m) of norm parallel phi(sub m) = 1, called point shift differentials. It is shown that the phi(sub m) form Hamilton sequences for the extremal mappings which take z(sub 0) into boundary points of V[z(sub 0)]. From that it follows, using the frame mapping criterion, that the phi(sub m) depend continuously in norm of the point w(sub m). Their constant dilatation K[w(sub m)] is called the dilatation function. Based on variational method for point shift mappings, it is shown that the level lines of K[w(sub m)] are Jorden curves separating V[z(sub 0)] from partial derivative of D(sub w). Thus, V[z(sub 0)] is a compact, connected set without holes.
Author

Differential Geometry; Invariant Imbeddings; Conformal Mapping

19990053846 Canterbury Univ., Dept. of Mathematics and Statistics, Christchurch, New Zealand

Initial Limits of Temperatures on Arbitrary Open Sets

Watson, Neil A., Canterbury Univ., New Zealand; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23,

pp. 495-506; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

Let D and E be open subsets of R(sup n + 1) that meet R(sup n) x {0}, Let E be bounded with bar-E is contained as a subset within D, and let D(sub +) = D intersection (R(sup n) x]0, infinity[). Given a nonnegative temperature u on D(sub +), we express its restriction to E(sub +) as the sum of a temperature which vanishes at time zero, and Gauss-Weierstrass integral. This enables us to use several theorems about the initial behavior of Gauss-Weierstrass integrals to prove similar results for u.
Author
Potential Theory; Set Theory

19990053847 Kiel Univ., Mathematisches Seminar, Germany
Conjugations on Rotation Domains as Limit Functions of the Geometric Means of the Iterates
Bargmann, Detlef, Kiel Univ., Germany; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 507-524; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

Let E be a region in C an h: E maps to E be a holomorphic function such that the family {h(sup n) : n in N} of iterates is normal, does not contain id(sub E), and only possesses non-constant limit functions. It is proved by elementary function theoretic arguments that the geometric means of the iterates converge to an injective holomorphic function phi which conjugates h to an irrational rotation. Subsequently it is outlined how to use this theorem to get a more elementary access to the classification theorem of periodic components of the Fatou set.
Author
Meromorphic Functions; Iteration; Analytic Functions

19990053848 Michigan Univ., Dept. of Mathematics, Ann Arbor, MI USA
Quasiconformality and quasisymmetry in Metric Measure Spaces
Tyson, Jeremy, Michigan Univ., USA; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 525-548; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

A homeomorphism f: X maps to Y between metric spaces is called quasisymmetric if it satisfies the three-point condition of Tukia and Vaisala. It has been known since the 1960's that when X = Y = R(sup n) (n is greater than = 2), the class of quasisymmetric maps coincides with the class of quasiconformal maps, i.e. those homeomorphisms f: R(sup n) maps R(sup n) which quasipreserve the conformal moduli of all families of curves. We prove that quasisymmetry implies quasiconformality in the case that the metric spaces in question are locally compact and connected and have Hausdorff dimension Q is greater than 1 quantitatively. The main conceptual tool in the proof is a discrete version of the conformal modulus due to Pansu.
Author
Geometry; Metric Space; Conformal Mapping

19990053849 Saarland Univ., Fachbereich 9 Mathematik, Saarbruecken, Germany
Second Order Obstacle Problems for Vectorial Functions and Integrands with Subquadratic Growth
Fuchs, M., Saarland Univ., Germany; Li, Gong-Bao, Wuhan Inst. of Physics and Mathematics, China; Annals of the Finnish Academy of Sciences: Mathematics; 1998; Volume 23, pp. 549-558; In English; See also 19990053834; Copyright; Avail: Issuing Activity (Dept. of Mathematics, P.O. Box 4, FIN-00014 University of Helsinki, Finland), Hardcopy, Microfiche

It is shown that the obstacle problem associated with the second order variational integral: integral(sub OMEGA) (1 + [absolute value of del(sup 2)](sup 2))(sup p/2) dx has a unique solution u in the class C9sup 1, alpha) for any alpha is less than 1 (n = 2) and for alpha = 1 - 1/p (n = 3).
Author
Calculus of Variations; Variational Principles; Optimization

19990054555 University of Electro-Communications, Div. of Natural Sciences and Health-Physical Education, Tokyo, Japan
The Generator of the Solution Semigroup for the General Linear Functional Differential Equation
Naito, Toshiki, University of Electro-Communications, Japan; Shin, Jong Son, Korea Univ., Korea, Republic of; Murakami, Satoru, Okayama Univ. of Science, Japan; Bulletin of the University of Electro-Communications; June 1998; Volume 11, No. 1, pp. 29-38; In English; See also 19990054551; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The generator of the solution semigroup for the general linear functional differential equation with infinite delay taking the values in a Banach space is given in terms of the linear operators contained in the equation. Some exact solutions are obtained from the generalized eigenfunctions of the generator.
Author
Differential Equations; Solutions

19990054596 National Taiwan Univ., Dept. of Civil Engineering, Taipei, Taiwan, Province of China
Approximate Estimations of Variance Components in an Adjustment Computation
Hsu, Rong-Shin, National Taiwan Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 69-77; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

An alternative expression has been derived for the variance factors when estimating weights according to the Iterated Almost Unbiased Estimation (IAUE) technique. The variance factors are expressed in terms of the redundancy numbers of the observed quantities. A variance factor can also be approximately estimated by finding the ratio of the redundancy numbers at any two successive interations. The numerical example of the first-order leveling network of Taiwan indicates: that stabilization of the redundancy number of an observation occurs as the variance factor associated with it converges to unity; and that for those variance factors which fail to converge, the redundancy numbers of the corresponding observations tend to decrease monotonically as the iteration proceeds.
Author
Redundancy; Estimates; Estimating; Computation

65
STATISTICS AND PROBABILITY

Includes data sampling and smoothing: Monte Carlo method; and stochastic processes.

19990054648 National Yun-Lin Univ. of Science and Technology, Dept. of Industrial Engineering and Management, Touliu, Taiwan, Province of China
A Comparative Study on the Estimators of Standard Deviation in Statistical Process Control
Chou, Chao-Yu, National Yun-Lin Univ. of Science and Technology, Taiwan, Province of China; Wang, Pin-Hao, National Yun-Lin Univ. of Science and Technology, Taiwan, Province of China; Jiang, Bernard C., Yuan-Ze Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers. Special Issue: Materials Science and Engineering; January 1999; ISSN 0253-3839; Volume 22, No. 1, pp. 109-116; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Since the 1930s statistical methods applied to industrial process control have received much attention. Many techniques of statistical process control, such as control chart and process capability analysis, require knowledge of process standard deviation. Therefore, estimation of the process standard deviation plays an important role in statistical process control. In this article, we reviewed four widely used estimators of standard deviation and derived the efficiency of each estimator. Then, these four estimators of standard deviation were compared based on their efficiencies. From the comparative studies, we suggest that if the sample size is greater than or equal to 6, the second, third and fourth estimators may be used to estimate process standard deviation. However, if the sample size is less than or equal to 5, then the third and fourth estimators should be preferred.
Author
Estimating; Standard Deviation; Variance (Statistics); Range (Extremes); Statistical Tests; Statistical Analysis

66
SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

19990053509 Georgia Inst. for Research, Atlanta, GA USA
HH-60G Mission Usage Spectrum Survey Methodology Overview
Crawford, Charlie, Georgia Inst. for Research, USA; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 57-73; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

(1) The USAF worst case spectrum defined less damaging than army estimated UH-60A/L spectrum: Survey yields less time at GW greater than 20K than any service spectrum. USAF spends more time in hover/low speed FLT. Auto entries/recoveries 235% more FLT time with training A/C. Weapons school aircraft incur most damaging FLT time. Measured GAG cycles are about half spectrum estimates. (2) The logged FLT time AVGS 15% greater than recorded FLT time, effectively reducing CRTs and increasing FLT maintenance time. (3) The ERITS is an effective tool for quantifying maneuver severity. (4) The potential impact on CRTs is positive for 9 of 10 components.(5) to reduce MR HUB CRT from 5100 to 5000 fit hrs. is a potential needs. (6) It is conservative for USAFs to continue use of UH-60A/L CRTs.
CASI
Procedures; Cycles; Damage; Hovering; Low Speed; Maintenance; Surveys

19990053660 Naval Postgraduate School, Monterey, CA USA
Component Based Simulation of the Space Operations Vehicle and the Common Aero Vehicle
Pournelle, Phillip E.; Mar. 1999; 135p; In English
Report No.(s): AD-A363022; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The desire of modem military and political leaders to conduct accurate and effective strike missions on enemy military targets using limited resources, with a minimal risk to US resources and personnel, in a timely manner is in direct competition with an adversary's goal of defending his territory and assets. An adversary can threaten, deter or even destroy strike assets used to attack him using IADS, aircraft and other means. New technologies may enable the USA to strike potential opponents in a timely fashion. The Space Operations Vehicle (SOV) is a low earth orbit capable space vehicle being developed by Phillips Laboratories at Kirtland AFB, New Mexico. The SOV will be a cross between the space shuttle and an F-14 fighter, a rugged low earth orbit capable vehicle designed to conduct multiple sorties for military purposes. This thesis develops a software component architecture and component library for building simulations for analysis of current and proposed military systems such as the SOV. This software package will support the Simulation Based Acquisition (SBA) process through all the phases and milestones of a program and help ensure the USA obtains the best equipment to maintain its edge on the battlefield.
DTIC
Air Defense; Space Missions; Computer Aided Design; Software Engineering; Computerized Simulation

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PHYSICS (GENERAL)

For precision time and time interval (PTTI) see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.

19990054467 National Lab. for High Energy Physics, Tsukuba, Japan
Proceedings of the International Workshop on Science in Neutron-arena of JHP
Ikeda, Hironobu, Editor, National Lab. for High Energy Physics, Japan; Furusaka, M., Editor, National Lab. for High Energy Physics, Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996; 112p; In English; Science in Neutron-arena of JHP, 26-27 Mar. 1996, Tsukuba, Japan; See also 19990054468 through 19990054484; Original contains color illustrations
Report No.(s): KEK-Proceedings-96-1; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The 'International Workshop on Science in Neutron Arena of Japan Hadron Project (JHP)' was convened March 26-27, 1996. Many impressive and exciting ideas were presented at the workshop including many novel ideas and entirely new research fields that are being considered through the use of such an intense pulse neutron source. It is a revolutionary era, similar to 30 years ago, when the novel idea of the triple-axis method was invented by Bert Brockhouse to measure the dispersion curves of elemental excitations in solids such as phonons and spin-waves became reality. In the exciting two day workshop, much research was proposed for the use of the high flux pulsed neutron source of JHP. Other subjects which were discussed included: the application of high intensity neutron beams to the material science; and technical approaches to solve a number of difficult problems being faced in advanced technology. Since this field of industrial application is still very immature, particularly in Japan, we believe that it is the time to develop a new community organizing the users from the Japanese industrial area.
Derived from text
Condensed Matter Physics; Conferences; Neutron Beams; Neutron Sources; Hadrons

19990054480 NEC Research Inst., Princeton, NJ USA

Magnetic fluctuations and the JHP

Aeppli, G., NEC Research Inst., USA; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 65-68; In English; See also 19990054467; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

Since spin waves were first observed, neutrons have played a unique role in imaging magnetic fluctuations in solids. Such fluctuations play a central role in fields as diverse as classical statistical mechanics, the quantum many-body problem, practical magnets and superconductivity. Triple-axis spectroscopy has been very successful, due to its data handling requirements which have been compatible with current computing abilities. This has not been the case for time-of-flight spectroscopy, until recently. There are many important discoveries made involving neutrons. While neutrons have played a significant role in condensed matter physics, they can continue to do so only if their capabilities continue to grow. The Japanese Hadron Project offers the possibility to improve the improve the use of neutrons for imaging of magnetic fluctuations.

CASI

Condensed Matter Physics; Imaging Techniques; Neutrons; Spectroscopy; Magnetic Variations; Solids; Neutron Sources; Particle Accelerators

19990054481 Tokyo Univ., Neutron Scattering Lab., Japan

Spin fluctuations in low-dimensional magnets: Spin excitations in the dimerized, S=1/2 antiferromagnetic chain system CuGeO3

Kakurai, K., Tokyo Univ., Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 69-74; In English; See also 19990054467; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The characterization of spin fluctuations in CuGeO3, a dimerized, quasi one dimensional antiferromagnetic system, by way of inelastic neutron scattering both at steady state and pulsed neutron source are briefly reviewed. The triplet nature of the excited gap state is clarified by polarized neutron inelastic scattering using triple axis spectrometer PONTA at the research reactor JRR-3M. The existence of the spin excitation continuum is demonstrated by others on the chopper instrument MARI at the Spallation source ISIS.

Author

Antiferromagnetism; Inelastic Scattering; Neutron Scattering; Neutron Sources; Dimerization; Polarization Characteristics

19990054551 University of Electro-Communications, Tokyo, Japan

Bulletin of the University of Electro-Communications, Volume 11

June 1998; ISSN 0915-0935; 130p; In Japanese; In English; See also 19990054552 through 19990054555; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The following subjects are reported: piezoelectric properties of La3Ta(0.5)Ga(5.5)O14 single crystal, piezoelectric properties in alpha - incommensurate - and beta - phases of quartz SiO2, modified hele-shaw moving boundary problem related to some phase transition phenomena, and the generator of the solution semigroup for the general linear functional differential equation.

Derived from text

Piezoelectric Crystals; Boundary Value Problems; Piezoelectricity

71
ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see 45 Environmental Pollution.

19990053901 Department of the Navy, Washington, DC USA

Echo Simulator for Active Sonar

Costa, David R., Inventor; Oct. 27, 1998; 9p; In English; Supersedes US-Patent-Appl-SN, AD-D018766.

Patent Info.: Filed 9 Oct. 97,; US-Patent-Appl-SN-954,884

Report No.(s): AD-D019326; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The invention pertains to a target echo simulator with reverberation and ambient noise for testing an active sonar system. A transmit enable pulse from a sonar transmitter establishes a sequence of operations in which a target echo generator, reverberation generator and ambient noise generator produce a composite signal. The target echo generator produces a pulse modulated output pulse of a characteristic sonar frequency. The reverberation generator produces an amplitude modulating or envelope controlled output at a frequency of a carrier that is offset from the target echo carrier frequency. An ambient noise generator constantly pro-

duces ambient noise. A summing amplifier combines the generated signals to produce a composite signal for transfer to a receive connection on the active sonar system.
DTIC
Noise (Sound); Noise Generators; Reverberation; Target Simulators; Targets

19990053913 Department of the Navy, Washington, DC USA
Concentric Fluid Acoustic Transponder
Ream, Donald E., Jr, Inventor; Oct. 13, 1998; 30p; In English
Patent Info.: Filed 13 Aug. 97,; US-Patent-Appl-SN-910,620; US-Patent-5,822,272
Report No.(s): AD-D019304; No Copyright; Avail: US Patent and Trademark Office, Microfiche

An acoustic transponder method and apparatus provides a high degree of frequency and target strength selectivity by utilizing two or more concentrically disposed, hollow spheres each containing acoustically refractive fluids. The invention provides the possibility of using spheres of a variety of diameters and as well a number of different refractive fluids, enabling the production of an acoustic transponder having a wide variety of selective frequency responses as well as effective target diameters.
DTIC
Homing Devices; Audio Equipment; High Frequencies

19990054155 Atlanta Univ., GA USA
Laser Doppler Velocimeter and High Speed Imaging System for Fluid Dynamics, Combustion and Chemical Kinetics Research ***Final Report, 15 Mar. 1997 - 28 Feb. 1999***
Yeboah, Yaw D., Atlanta Univ., USA; Apr. 1999; 24p; In English
Contract(s)/Grant(s): N00014-97-1-0511
Report No.(s): AD-A362940; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Laser Doppler Velocimetry (LDV) system and a high speed imaging system were acquired for the Department of Defense (DoD) Grant N00014-97-1-0511 and setup in the Combustion and Emission Control Laboratory at Clark Atlanta University. These instruments have provided an integrated diagnostic system in the areas of combustion, propulsion, emission control, chemical kinetics and fluid dynamics for time resolved flow visualization and detailed quantitative measurements of flow velocities in complex reacting and non-reacting flows. Research projects supported with the acquired instruments included: turbulent premixed combustion, optimization of non-thermal plasma discharge for pollution control, droplet behavior under supercritical conditions, interaction between acoustic waves and fuel droplets and sprays, and combustion instabilities in ramjet combustors. The instruments will also be used on the precombustion pyrolytic degradation of hydrocarbon fuels under normal and microgravity conditions. Seven (7) undergraduate and graduate students from the Department of Engineering and Department of Chemistry at Clark Atlanta University have, so far, been trained and educated on the instruments. The acquired instrumentation has significantly strengthened the University's research infrastructure, and enhanced CAU's capabilities to undertake research that is relevant to the critical technology areas of DoD. These include the chemical kinetics, combustion and propulsion, and fluid dynamics programs of the Army Research Lab (ARL); the aerodynamics, turbulence and internal flows, air-breathing combustion, space power and propulsion, and physical mathematics and applied analysis programs of the Air Force Office of Scientific Research (AFOSR); and the turbulence, propulsion and flow structure interactions, and propulsion programs of the Office of Naval Research (ONR).
DTIC
Laser Doppler Velocimeters; Fluid Dynamics; Image Processing; Imaging Techniques; Particle Image Velocimetry; Flow Visualization; Velocity Measurement

19990054159 Department of the Navy, Washington, DC USA
Acoustic Sound Speed Profiling System
Stottlemyer, Thomas R., Inventor; Dec. 21, 1998; 12p; In English
Patent Info.: Filed 21 Dec. 1998; US-Patent-Appl-SN-09/226,625
Report No.(s): AD-D019337; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

An acoustic sound speed profiling system is provided. The system includes a sound emitter and a series of sensors or hydrophones spaced vertically in a water column. The sound emitter is a high-frequency sound source adapted for mounting on the front end of a passive, towed sonar array. The sound source has a frequency which may be outside the acoustic aperture of the towed array. The series of sensors are located at intervals along and embedded within the array tow cable. The sensors are conventional hydrophones or thin-film hydrophone membranes. During operation of the system, the source transmits high frequency sound, which is received by each sensor along the tow cable of the towed array. Calculation of the speed of sound is determined from

the position of the tow cable and the time-of-arrival of acoustic signals at each sensor. There is no interference with the normal operation of the passive towed array.
DTIC
Underwater Acoustics; Acoustic Velocity; Ultrasonic Radiation; Acoustic Propagation; Signal Transmission

19990054167 Department of the Navy, Washington, DC USA
Method and System for Processing Acoustic Signals
Quazi, Azizul H., Inventor; Nov. 24, 1998; 13p; In English; Supersedes US-Patent-Appl-SN-890479, AD-D018635.
Patent Info.: Filed 9 Jul. 97,; US-Patent-5,841,735; US-Patent-Appl-SN-890,479
Report No.(s): AD-D019299; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a method for processing acoustic signals received by first and second underwater detectors, spaced from each other, for detection and determination of range and bearing of an underwater signal source, includes the steps of obtaining a time series xd of first random variables X from the first detector, obtaining a time series yd of second random variables Y from the second detector, and providing a window of a selected number of digital points of time series xd and yd. The method further includes determining distribution of p(x,y), p(x), and p(y), wherein p(x,y)=joint distribution, p(x)=distribution of x, and p(y)=distribution of y, and estimating mutual information I(X;Y) of the random variables X,Y whereby to obtain a measure of dependence between the random variables X and Y in the window, whereby to determine whether xd and yd come from a single source, and if xd and yd are determined to have come from the same source, computing time differential in receipt of the X and Y signals by the first and second spaced detectors to provide the range and bearing of the source from the first and second detectors. The invention further relates to a system for performing the steps of the above method.
DTIC
Underwater Acoustics; Time Series Analysis; Estimating; Rangefinding

19990054173 Department of the Navy, Washington, DC USA
Mandrell Based Embedded Planar Fiber-Optic Interferometric Acoustic Sensor
Lagakas, Nicholas, Inventor; Bucaro, Joseph A., Inventor; Oct. 20, 1998; 17p; In English; Supersedes US-Patent-Appl-SN, AD-D016229.
Patent Info.: Filed 28 Feb. 94,; US-Patent-Appl-SN-202,628; US-Patent-5,825,489
Report No.(s): AD-D019330; No Copyright; Avail: US Patent and Trademark Office, Microfiche

This invention is an optimized planar fiber optic sensor utilizing robust design having high acoustic sensitivity and reduced acceleration response over that found in the prior art. A continuous optical fiber sensing arm is wrapped around a plurality of mandrels to reduce acceleration effects. An optical fiber sensing arm is embedded in an epoxy material to effectively eliminate the effects of the acoustic medium on the reference arm. The sensing arm and reference arm, along with input and output coupler, are encapsulated within an elastomer, natural rubber or butyl rubber which is an active element that providing high acoustic sensitivity. The mandrels may be solid compliant mandrels, tubular cylindrical mandrels and combinations thereof.
DTIC
Epoxy Resins; Elastic Properties; Signal Detectors; Acoustics

19990054581 Army Research Lab., Information Science and Technology Branch, Adelphi, MD USA
Weak Scattering of Sound Waves in Random Media That Have Arbitrary Power-Law Spectra ***Final Report, 1 Oct. - 15 Nov. 1998***
Wilson, D. K., Army Research Lab., USA; Apr. 1999; 25p; In English
Contract(s)/Grant(s): AF Proj. B53A
Report No.(s): AD-A363637; ARL-TR-1866; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Log-amplitude and phase variances of a weakly scattered acoustic signal are calculated for line-of-sight propagation through a random medium. The spectrum of the index-of-refraction fluctuations in the random medium is assumed to scale in proportion to the wavenumber raised to an arbitrary power in the limit of large wavenumbers (small spatial scales). Both scalar and vector contributions to the index of refraction are considered. Most of the calculated results reduce to those given by Tatarskii (1971) and Ostashev (1994) when the power law exponent is -5/3, which is the value characteristic of turbulence. However, the results do not exactly reduce to an equation given by Flatte et al (1994) for the log-amplitude variance in terms of strength and diffraction parameters. The equation from Flatte et al is shown to be an approximation, strictly valid only when the spectral energy in the random medium is concentrated at a well-defined outer scale.
DTIC
Sound Waves; Acoustic Scattering; Power Spectra; Signal Transmission

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ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

19990053829 Communications Research Lab., Tokyo, Japan
Research on Nanotechnology and Molecular Electronics
Mashiko, Shinro, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 671-675; In Japanese; See also 19990053822; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The principal interest of the nano technology group is the study of organic molecular materials and devices, whose high functionality in very small pieces expresses great potential to produce fast and large capacity information transmission systems for the future multi media interactive communication age. Because of the limited performance of the present conventional communication devices, development of new types of devices based on novel principles is craved for bringing out the fast data transmission and processing to the real world. Devices based on organic molecules and biological molecules are considered as great candidates to make a breakthrough to the real information generation, Organic and biological molecules have unlimited varieties of functions and selectivity (e.g. sensitive recognition of environmental perturbation, self assembling the structures, an appropriate judgment in chaotic situations, etc.) with high efficiency. The primal object of our research is the discovery of new functions for creating the large volume mutual telecommunication systems by manipulating multi dimensional structure from the molecular scale.

Author
Research; Organic Materials; Perturbation; Data Transmission

19990054196 Sandia National Labs., Albuquerque, NM USA
Stability of trapped electrons in SiO2
Fleetwood, D. M.; Winokur, P. S.; Flament, O.; Leray, J. L.; Dec. 31, 1998; 4p; In English; IEEE semiconductor interface specialists conference
Report No.(s): DE98-006157; SAND-98-1898C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Electron trapping near the Si/SiO2 interface plays a crucial role in mitigating the response of MOS devices to ionizing radiation or high-field stress. These electrons offset positive charge due to trapped holes, and can be present at densities exceeding 10(exp 12) cm(sup -2) in the presence of a similar density of trapped positive charge. The nature of the defects that serve as hosts for trapped electrons in the near-interfacial SiO2 is presently unknown, although there is compelling evidence that these defects are often intimately associated with trapped holes. This association is depicted most directly in the model of Lelis et al., which suggests that trapped electrons and holes occupy opposite sides of a compensated E center in SiO2. Charge exchange between electron traps and the Si can occur over a wide range of time scales, depending on the trap depth and location relative to the Si/SiO2 interface. Here the authors report a detailed study of the stability of electron traps associated with trapped holes near the Si/SiO2 interface.

NTIS
Trapped Particles; Silicon; Silicon Oxides; Semiconductor Devices; Trapping; Ionizing Radiation

19990054468 National Lab. for High Energy Physics, Tsukuba, Japan
JHP neutron-arena plan
Ikeda, H., National Lab. for High Energy Physics, Japan; Furusaka, M., National Lab. for High Energy Physics, Japan; Proceedings of the International Workshop on Science in Neutron-arena of JHP; May 1996, pp. 1-3; In English; See also 19990054467; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The Japanese Hadron Project (JHP) consisted of four facilties: (1) N-arena (a high power pulsed spallation neutron source), (2) M-arena (meson science), (3) E-arena (unstable nuclear beam) and (4) K-arena (nuclear and particle physics). JHP is based on a 200 MeV, 400 Micro Angstrom Linac, a 3 GeV 200 Micro Angstrom, 0.6 (1.2) MW rapid cycle synchrotron and a 50 Ge/V, 5 (10) micro Angstrom Synchrotron. Conceptual design of N-arena, for example, a target station, a target moderator reflector assembly (TMRA) and instruments is underway now. Systematic research and development of high efficiency TMRA is also underway.

Author
Linear Accelerators; Neutron Sources; Synchrotrons; Research Facilities

19990054469 Rutherford Appleton Lab., ISIS Facility, Chilton, UK

Future opportunities with pulsed neutron sources

Taylor, A. D., Rutherford Appleton Lab., UK; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 4-9; In English; See also 19990054467; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

ISIS is the world's most powerful pulsed spallation source and in the past ten years has demonstrated the scientific potential of accelerator-driven pulsed neutron sources in fields as diverse as physics, earth sciences, chemistry, materials science, engineering and biology. The Japan Hadron Project gives the opportunity to build on this development and to further realize the potential of neutrons as a microscopic probe of the condensed state.

Author

Neutron Sources; Neutron Emission; Neutron Scattering; Condensed Matter Physics; Spallation

19990054470 University Coll., Dept. of Physics and Astronomy, London, UK

New Science at the European Spallation Source

Finney, John L., University Coll., UK; Proceedings of the International Workshop on Science in Neutron-arena of JHP; May 1996, pp. 10-15; In English; See also 19990054467; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The European Spallation Source is a trans-European project aimed at the ultimate construction of a next-generation pulsed spallation neutron source that wil deliver 30 times the beam power of ISIS. The reference design for the proposed source has been set and work is in progress to develop an updated scientific case for the construction of the source early in the next century. Together with improvements in instrumentation, effective flux gains of over two orders of magnitude are likely in some areas, opening up major new opportunities for the exploitation of neutron studies in fundamental strategic, and applied science.

Author

Neutron Sources; Spallation; Research Facilities; Particle Accelerators

19990054471 Los Alamos National Lab., Los Alamos Neutron Science Center, NM USA

Spallation Sources in Support of Technology

Pynn, Roger, Los Alamos National Lab., USA; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 16-23; In English; See also 19990054467; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

In this contribution I summarize a number of recent experiments at the Los Alamos Neutron Science Center (LANSCE) that have contributed to strategic and applied research. A number of new tools have been developed to address these problems, including software that allows materials texture to be obtained during Rietveld refinement, Bragg-edge diffraction, resonant-neutron and proton radiography. These tools have the potential to impact basic as well as applied research. It is clear that a new, more powerful neutron source such as the planned Japanese Hadron Project will be able to use these and other techniques to contribute in a direct way to important industrial technologies.

Author

Bragg Angle; Diffraction; Neutron Sources; Spallation; Technology Assessment

19990054472 Los Alamos National Lab., Chemical Science and Technology Div., NM USA

Neutron Scattering Applications in Structural Biology: Now and the Future

Trewhella, Jill, Los Alamos National Lab., USA; Proceedings of the International Workshop on Science in Neutron-arena of JHP; May 1996, pp. 24-29; In English; See also 19990054467; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Neutrons have an important role to play in structural biology. Neutron crystallography, small-angle neutron scattering and inelastic neutron scattering techniques all contribute unique information on biomolecular structures. In particular, solution scattering techniques give critical information on the conformations and dispositions of the components of complex assemblies under a wide variety of relevant conditions. The power of these methods is demonstrated here by studies of protein/DNA complexes and Ca(+2)-binding proteins complexed with their regulatory targets. In addition we demonstrate the utility of a new structural approach using neutron resonance scattering. The impact of biological neutron scattering to date has been constrained principally by the available fluxes at neutron sources and the potential of these approaches will only be realized with the development of new more powerful neutron sources.

Author

Crystallography; Neutron Scattering; Neutron Sources; Deoxyribonucleic Acid

19990054476 National Lab. for High Energy Physics, Tsukuba, Japan

Hydrogen in solids: Wave functions and potential

Ikeda, S., National Lab. for High Energy Physics, Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 45-49; In English; See also 19990054467; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

A new approach of neutron scattering, S(Q,epsilon(sub n))-map measurement is proposed which is very useful for extracting the hydrogen potential directly. This approach will be important for the investigation of biological materials.

Author

Hydrogen; Neutron Scattering; Wave Functions; Inelastic Scattering; Solids

19990054477 Osaka Univ., Dept. of Chemistry, Osaka, Japan

Structure and dynamics of adsorbed monolayers as studied by neutron scattering

Inaba, Akira, Osaka Univ., Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 50-53; In English; See also 19990054467; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche

The structure and dynamics of the monolayers physically absorbed on the surface of graphite has been studied by neutron scattering. For a better understanding of the results, calorimetric measurements have also been performed. Rotational tunneling of isotopic methanes and orientational order-disorder of some simple molecules is investigated.

Author

Adsorption; Graphite; Isotopes; Methane; Resonant Tunneling; Neutron Spectrometers

19990054478 National Lab. for High Energy Physics, Tsukuba, Japan

Neutron and P, T symmetry

Masuda, Y., National Lab. for High Energy Physics, Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 54-59; In English; See also 19990054467; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

New ideas for experiments to improve the T-violation limit by a factor of 10 to 100 are discussed for an intensive spallation neutron source. The methods to improve the limit of the right-handed current and the neutron lifetime are also discussed.

Author

Neutron Sources; Neutrons; Spallation; Symmetry; Electric Dipoles; Quantum Chromodynamics

19990054482 Argonne National Lab., Materials Science Div., IL USA

Magnetic inelastic scattering: Present results and future trends

Osborn, R., Argonne National Lab., USA; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 75-80; In English; See also 19990054467

Contract(s)/Grant(s): W-31-109-eng-38; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Experience over the last 15 years has shown that pulsed neutron spectrometers are able to make a unique contribution to the field of magnetic inelastic scattering. Pulsed neutron spectrometers are characterized by high resolution and wide dynamic range both of which are necessary in order to characterize the magnetic response of the complex systems of current interest, ranging from rare earth transition metal permanent magnets to quantum critical scatterers. However, all these studies have been constrained by current flux limitations. The development of more powerful spallation neutron sources, such as the JHP is likely to transform these investigations from interesting demonstrations of the potential of pulsed neutron scattering into routine tools for the study of magnetic correlations.

Author

Complex Systems; Inelastic Scattering; Neutron Scattering; Neutron Sources; Neutron Spectrometers; Condensed Matter Physics; High Resolution; Energy Transfer

19990054587 Romanian Center for Induced Gamma Emission, Bucharest, Romania

Investigation of K-Mixing in Nuclei with Isomeric States ***Final Report***

Popescu, Ioan-Iovitz; Jan. 1999; 11p; In English

Contract(s)/Grant(s): F61708-98-W-0027

Report No.(s): AD-A363732; EOARD-SPC-98-4017; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking Romanian Center for Induced Gamma Emission as follows: The contractor will (a) travel to Orsay, France to participate in the data collection; (b) reduce some of the data at RC-IGE in Bucharest; (c) review the data and decide analytical strategies; and (d) review results and develop a sequent publications summarizing the results.

DTIC

Gamma Rays; Emission; Nuclei; Isomers

73
NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory. For space radiation see 93 Space Radiation.

19990053588 Maribor Univ., Maribor, Slovenia
Hundred Years of Particle Accelerators ***Stolet Pospesevalnikov***
Paulin, Alojz, Maribor Univ., Slovenia; Electrotechnical Review; 1998; Volume 65, Nos. 2-3, pp. 116-126; In English; See also 19990053584; No Copyright; Avail: Issuing Activity (Elektrotehniski Vestnik, Fakulteta za Elektrotrhniko, Trzaska 25, 1001Ljubljana, Slovenia), Hardcopy, Microfiche

A short description of early inventions of particle accelerators at the end of the 19tl' and the first half of the 20th century is presented. As far as possible the early historical photos and drawings of this early apparatus are presented. Further in the paper the development of these historical inventions into the most sophisticated scientific machines of our time, and their possible development in the next century is described. These machines have always been the best users of vacuum practice, and a challenge to vacuum science from 10(exp -3) mbar (hPa) in the last century up to 10(exp-12) mbar or if possible still better nowadays.
Author
Particle Accelerators; Histories

74
OPTICS

Includes light phenomena; and optical devices. For lasers see 36 Lasers and Masers.

19990053697 Naval Postgraduate School, Monterey, CA USA
Strehl Ratio Probabilities for Phase-Only Adaptive Optics
Ambrose, Charles R.; Mar. 1999; 80p; In English
Report No.(s): AD-A362881; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Atmospheric turbulence will induce phase and amplitude fluctuations in propagating electromagnetic waves, such as a laser beam. Adaptive optical systems attempt to compensate for these distortions. The Strehl ratio is a measure of the peak, on-axis intensity after propagation through turbulence divided by the peak irradiance for vacuum propagation. This thesis investigated the probability distribution of the Strehl ratio of a perfect, phase-only, adaptive optical system as a function of the atmospheric coherence length Ro divided by the actuator spacing, d. Using an efficient Fourier algorithm and 28 workstations running in parallel, over 850 million computer simulations were performed for 25 different Ro/d ratios in order to produce a histogram of the irradiance probability distribution. The results show that the Strehl ratio follows a log-normal probability distribution even for very small probabilities. A second set of computer simulations introduced intensity scintillation by including the log-amplitude variance parameter, cu. sigma sub l. Much faster, state-of-the-art computer workstations enabled over two billion realizations on 18 machines running in parallel for comparable time periods. The trends of these results are more complex and will require further research and deeper investigation.
DTIC
Computerized Simulation; Adaptive Optics; Atmospheric Turbulence; Scintillation; Irradiance; Probability Theory

19990053703 Schafer Corp., Albuquerque, NM USA
Support for Starfire Optical Range
Ellerbroek, Brent L.; Tyler, David W.; Feb. 1999; 41p; In English
Contract(s)/Grant(s): N00014-97-D-2014
Report No.(s): AD-A361739; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The end-to-end performance achieved by an adaptive optical (AO) imaging system is determined by a combination of the residual time-varying phase distortions associated with atmospheric turbulence, and the quasi-static unsensed and uncorrectable aberrations in the optical system itself. Although the effects of these two errors on the time averaged Strehl ratio and the time averaged optical transfer function (OTF) of the AO system are not formally separable, such an approximation is found to be accurate to within a few per cent for a range of representative residual wave-front errors. In these calculations, we have combined static optical system aberrations and time-varying residual phase distortion characteristic of deformable mirror (DM) fitting error, wave-front sensor (WFS) noise, and anisoplanatism. The static aberrations consist of focus errors of varying magnitudes as well as a combination of unsensed and uncorrectable mirror figure errors derived from modeling by the Gemini beta-meter Telescopes proj-

ect. The overall Strehl ratios and OTF's due to the combined effect of these error sources are well approximated as products of separate factors for the static and time-varying aberrations, as long as the overall Strehl ratio due to both errors is greater than about 0.1. For lower Strehl ratios the products provide lower bounds on the actual values of the Strehl ratio and OTF. The speckle transfer function (STF) is also well approximated by a product of two functions, but only where AO compensation is sufficiently good that speckle imaging techniques are usually not required.
DTIC
Telescopes; Adaptive Optics; Deformable Mirrors; Optical Transfer Function; Imaging Techniques

19990053880 COM DEV Ltd., Space Group, Cambridge, Ontario Canada
A Length Modulated Cell for Remote Sounding of Greenhouse Gases
Gibson, Andrew S., COM DEV Ltd., Canada; Hackett, John P., COM DEV Ltd., Canada; Bailak, George V., Toronto Univ., Canada; 33rd Aerospace Mechanisms Symposium; May 1999, pp. 309-324; In English; See also 19990053852; No Copyright; Avail: CASI; A03, Hardcopy; A04, Microfiche

The design and verification of a novel opto-mechanical filter device is described. The mechanism is required to provide rotation of precision optical elements at 69-84 rad/s. The liquid-lubricated bearing system is designed to meet a challenging lifetime requirement, involving continuous operation for over 5 x (10 exp 9) rotations while maintaining optical stability in the infra-red. Author
Mechanical Devices; Optical Equipment; Rotation; Bearings; Measuring Instruments; Service Life; Performance Tests

19990054166 Department of the Navy, Washington, DC USA
Method and Apparatus for Side Pumping an Optical Fiber
Goldberg, Lew, Inventor; Dec. 29, 1998; 9p; In English; Supersedes US-Patent-Appl-SN-568859, AD-D017926.
Patent Info.: Filed 7 Dec. 95,; US-Patent-5,854,865; US-Patent-Appl-SN-568,859
Report No.(s): AD-D019298; No Copyright; Avail: US Patent and Trademark Office, Microfiche

The invention pertains to a technique for the efficient coupling of pump light into a fiber by injecting the light through the side of a fiber leaving the fiber ends accessible to input and output coupling. This technique relies on the fabrication of a groove or a microprism into the side of the fiber. The groove shape is adapted effective to the variables of light wavelength, orientation of the source and variables relating to fiber construction so as to allow the efficient injection of pump light. Light emerging from a laser diode or other suitable means for launching light placed on the opposite side of the fiber, and in proximity to the fiber wall, propagates laterally through the fiber and impinges on the sides of the groove. The vertical rays impinging on the groove facets are specularly reflected and directed along the horizontal fiber axis of the outer core. by employing a reflective coating on the groove, the reflectivity of the groove facets approach 100% for a wide range of incidence angles. In this manner one can launch external optical signals into an optical fiber.
DTIC
Fiber Optics; Optical Pumping; Optical Fibers; Semiconductor Lasers; Optical Communication

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PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see90 Astrophysics.

19990053784 Lawrence Livermore National Lab., Livermore, CA USA
Progress in Fast Ignitor Research with the Nova Petawatt Laser Facility
Key, M. H., Lawrence Livermore National Lab., USA; Cowan, T. E., Lawrence Livermore National Lab., USA; Hammel, B. A., Lawrence Livermore National Lab., USA; Hatchett, S. P., Lawrence Livermore National Lab., USA; Henry, E. A., Lawrence Livermore National Lab., USA; Nov. 10, 1998; 12p; In English
Contract(s)/Grant(s): W-7405-ENG-48
Report No.(s): AD-A362957; UCRL-JC-132178; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The physics of fast ignition is being studied using a petawatt laser facility at the Lawrence Livermore National Laboratory. Performance of the PW laser with deformable mirror wavefront control giving intensities up to 3 x 10(exp 20) W/sq cm is described. Measurements of the efficiency of conversion of laser energy to relativistic electrons and of their energy spectrum and angular distribution including an observed narrow beam angle of +/- 15 deg, are reported. Heating by the electrons to near 1 keV

in solid density CD2 is inferred from the thermo-nuclear neutron yield. Estimates suggest an optimized gain of 300x if the National Ignition Facility were to be adapted for fast ignition.
DTIC
Ignition; Plasmas (Physics)

19990053795 Naval Research Lab., Washington, DC USA
Advanced Radiation Theory, Support Annual Report 1998 ***Final Report***
Apr. 27, 1999; 151p; In English
Contract(s)/Grant(s): MIPR Proj. 98-2051; MIPR-98-2174-923
Report No.(s): AD-A362872; NRL/MR/6720--99-8341; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report describes the work of the Radiation Hydrodynamics Branch during FY 98 in support of the DTRA PRS program. Critical issues covered are: (1) Large initial radius Z-pinch load behavior on Saturn, Double Eagle, DECADE QUAD, and Z pulsed power machines, (2) Analyzing temperature and density radial temperature gradients in Z-pinch plasmas, (3) Analysis of time resolved and time integrated Z-pinch data, (4) Spectroscopic PRS analysis, (5) Radiation magnetohydrodynamic code development and assessment, (6) Analysis of nested wire array loads, and (7) Basic tradeoffs of L-shell versus K-shell radiators.
DTIC
Magnetohydrodynamics; Zeta Pinch; Plasmas (Physics); Plasma Generators; Magnetohydrodynamic Generators; Magnetohydrodynamic Stability

19990053815 Lawrence Livermore National Lab., Livermore, CA USA
Sputter deposited beryllium fuel capsules for NIF
Alford, C. S.; Feb. 12, 1998; 11p; In English
Report No.(s): DE98-054674; UCRL-ID-129463; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The objective of our effort is to systematically study the properties of films produced under different conditions, with an emphasis on improving surface morphology and microstructure while studying permeability and capsule strength. We have made extensive use of atomic force and electron microscopy to determine the microstructure of the films, along with composition probes (mainly x-ray fluorescence) to quantify the chemical structure. Our studies can be roughly divided into three categories. First, there are those in which the effects of substrate biasing have been investigated. This includes varying the substrate voltage from 0 to 120 V and applying an intermittent bias. Next there are studies of Be combined with boron, a non-soluble dopant Because of it's low Z this dopant is of particular interest for x-ray related applications. Finally, there are experiments in which pulses of nitrogen are admitted to the vacuum chamber during deposition. The layers of nitride formed tended to disrupt the growth of Be grains, leading to a more fine-grained microstructure. For all these studies, we have most often used hollow plastic spheres for our substrate material. However, there have been some samples deposited on glass spheres or silicon flats.
NTIS
Fuel Capsules; Microstructure; Morphology; Beryllium; Sputtering; Thin Films

19990053817 Lawrence Livermore National Lab., Livermore, CA USA
Developing enabling optics finishing technologies for the National Ignition Facility
Aikens, D. M.; Rich, L.; Bajuk, D.; Slomba, A.; Jan. 08, 1998; 6p; In English; 1998 diffractive optic and micro-optics conference
Report No.(s): DE98-054776; UCRL-JC-129317; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Lawrence Livermore National Laboratory is in the process of constructing the National Ignition Facility, a half million square foot facility which will house a 192 beam laser system capable of generating the 2 million joules of ultraviolet light energy necessary to achieve fusion ignition with inertial targets by 2004. More than 7,000 meter class optics will need to be manufactured by LLNL's industrial partners to construct the laser system. In 1994, LLNL embarked on an ambitious optics finishing technology development program costing more than $6M over 3 years to develop these technologies, working with three suppliers of large precision optics. While each development program centered upon the specialties and often proprietary technologies already existing in the suppliers facility, many of the technologies required for manufacturing large precision optics at the lowest cost possible are common to two and in some cases all three efforts. This presentation describes the manufacturing process in a general sense which is used by all three of the companies under contract; Zygo Corporation, Tinsley Laboratories, and Eastman Kodak. In each of the principle process steps of shaping, grinding, polishing, figuring, and metrology, development highlights are discussed.
NTIS
Inertial Confinement Fusion; Optical Equipment; Research Facilities; Ignition

19990054179 Princeton Univ., Plasma Physics Lab., NJ USA

Energetic particle physics with applications in fusion and space plasmas

Cheng, C. Z.; Dec. 31, 1997; 31p; In English

Report No.(s): DE97-052910; PPPL-3247; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Energetic particle physics is the study of the effects of energetic particles on collective electromagnetic (EM) instabilities and energetic particle transport in plasmas. Anomalously large energetic particle transport is often caused by low frequency MHD instabilities, which are driven by these energetic particles in the presence of a much denser background of thermal particles. The theory of collective energetic particle phenomena studies complex wave-particle interactions in which particle kinetic physics involving small spatial and fast temporal scales can strongly affect the MHD structure and long-time behavior of plasmas. The difficulty of modeling kinetic-MHD multiscale coupling processes stems from the disparate scales which are traditionally analyzed separately: the macroscale MHD phenomena are studied using the fluid MHD framework, while microscale kinetic phenomena are best described by complicated kinetic theories. The authors have developed a kinetic- MHD model that properly incorporates major particle kinetic effects into the MHD fluid description. For tokamak plasmas a nonvariational kinetic-MHD stability code, the NOVA-K code, has been successfully developed and applied to study problems such as the excitation of fishbone and Toroidal Alfven Eigenmodes (TAE) and the sawtooth stabilization by energetic ions in tokamaks. In space plasmas the authors have employed the kinetic-MHD model to study the energetic particle effects on the ballooning-mirror instability which explains the multisatellite observation of the stability and field-aligned structure of compressional Pc 5 waves in the magnetospheric ring current plasma.

NTIS

Magnetohydrodynamics; Magnetohydrodynamic Stability; Magnetohydrodynamic Waves; Ballooning Modes; Energetic Particles; Tokamak Devices; Wave-Particle Interactions; Transport Properties

19990054198 Princeton Univ., Plasma Physics Lab., NJ USA

Conceptual design for the NSTX Central Instrumentation and Control System

Bashore, D.; Oliaro, G.; Sichta, P.; Tindall, K.; Dec. 31, 1997; 6p; In English; IAEA Technical Committee meeting on data acquisiton and management for fusion energy

Report No.(s): DE97-054046; CFP-3696; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The design and construction phase for the National Spherical Torus Experiment (NSTX) is under way at the Princeton Plasma Physics Laboratory (PPPL). Operation is scheduled to begin on April 30, 1999. This paper describes the conceptual design for the NSTX Central Instrumentation and Control (I and C) System. Major elements of the Central I and C System include the Process Control System, Plasma Control System, Network System, Data Acquisition System, and Synchronization System to support the NSTX experimental device.

NTIS

Tokamak Devices; Control Systems Design; Plasma Control; Plasma Physics; Numerical Control

19990054345 Lawrence Livermore National Lab., Livermore, CA USA

Laser conditioning study of KDP on the optical sciences laser using large area beams

Runkel, M.; DeYoreo, J.; Sell, W.; Milam, D.; Dec. 20, 1997; 16p; In English; Annual Boulder damage symposium on optical materials for high power lasers

Report No.(s): DE98-052076; UCRL-JC-128352; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Considerable attention has been paid over the years to the problem of growing high purity KDP and KD*P to meet threshold requirements on succeeding generations of inertial confinement fusion lasers at LLNL. While damage thresholds for these materials have increased over time, the current National Ignition Facility (NIF) maximum fluence requirement (redline) for KD*P frequency triplers of 14.3 J/cm(sup 2) at 351 nm, 3 ns has not been reached without laser (pre)conditioning. It is reasonable to assume that, despite the rapid increase in damage thresholds for rapidly grown crystals, -a program of large scale conditioning of the 192 NIF triplers will be required. Small area ramp (R/1) tests on single sites indicate that KDP damage thresholds can be raised on average up to 1.5X the unconditioned values. Unpublished LLNL 3(omega) raster conditioning studies on KDP, however, have not conclusively shown that off-line conditioning is feasible for KD*P. Consequently, investigating the feasibility of on-line conditioning of NIF triplers at 3(omega) has become a high priority for the KDP damage group at LLNL. to investigate the feasibility of on-line conditioning we performed a series of experiments using the Optical Sciences Laser (OSL) on numerous samples of conventional and rapid growth KDP and KD*P. The experiment entailed exposing sites on each sample to a range of ramped shot (N/l) sequences starting at average fluences of -2 J/cm(sup 2) (in a 7 mm 'top hat' beam (at) 351 nm, 3 ns) up to peak fluences of approximately 13 J/cm(sup 2). Test results indicated that the most effective conditioning procedure entailed a 7-8 shot ramp starting at 2 J/cm(sup 2) and ending at 12- 13 J/cm(sup 2). The pinpoint onset fluence for the 8/1 tests was 1.4 times that of the

unconditioned site. Damage evolution appears to be exponential as a function of increasing fluence. When damage occurs after conditioning however, pinpoint density evolution exhibits a greater slope than less conditioned sites. The overall reduction in the total pinpoint number can be as high as 30OX. Despite laser conditioning , the pinpoint onset for the samples considered is below the NIF redline fluence of 14.3 J/cm(sup 2). In addition, the exponential pinpoint evolution curves indicate that damage levels at NIF redline fluences will be on the order of 10(sup 4) pinpoints/mm(sup 2). This suggests that there will be significant damage in NIP triplers, however, substantial damage has not been observed in the large Beamlet tripler (conventionally grown KD*P) under similar exposure conditions. by applying the OSL damage evolution curves to model NIF THG output spatial profiles it is possible to show damage in NIF triplers will be slight, consisting of isolated clusters with a few pinpoints at high fluence portions of the beam. This prediction has been verified by scatter mapping the 37 cm Beamlet tripler crystal. These results will be discussed in a future memo. These results indicate the feasibility of on-line conditioning for the NIF laser.
NTIS
Inertial Confinement Fusion; Potassium Phosphates; Crystals; Lasers; Masers

19990054536 Princeton Univ., Plasma Physics Lab., NJ USA
DEGAS 2 neutral transport modeling of high density, low temperature plasmas
Stotler, D. P.; Karney, C. F. F.; Pigarov, A. Y.; Dec. 31, 1997; 8p; In English
Report No.(s): DE97-051503; PPPL-3221; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Neutral transport in the high density, low temperature plasma regime is examined using the DEGAS 2 Monte Carlo neutral transport code. DEGAS 2 is shown to agree with an analytic fluid neutral model valid in this regime as long as the grid cell spacing is less than twice the neutral mean-free path. Using new atomic physics data provided by the collisional radiative code CRAMD, DEGAS 2 is applied to a detached Alcator C-Mod discharge. A model plasma with electron temperature approximately 1 eV along detached flux tubes, between the target and the ionization front, is used to demonstrate that recombination is essential to matching the experimental data. With the CRAMD data, approximately 20% of the total recombination is due to molecular activated recombination.
NTIS
Monte Carlo Method; High Temperature Plasmas; Electron Energy; Tokamak Devices

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SOLID-STATE PHYSICS

Includes superconductivity. For related information, see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.

19990053575 Auburn Univ., Dept. of Electrical Engineering, AL USA
Synthesis of Diamond in High Power-Density Microwave Methane/Hydrogen/Oxygen Plasmas at Elevated Substrate Temperatures ***Final Report, 1 May 1998 - 30 Apr. 1999***
Chein, Tsan-Heui, Auburn Univ., USA; Wei, Jin, Auburn Univ., USA; Tzeng, Yonhua, Auburn Univ., USA; Apr. 30, 1999; 33p; In English
Contract(s)/Grant(s): N00014-98-1-0571
Report No.(s): AD-A362769; TR-2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Effects of elevated substrate temperatures and oxygen additive on the chemical vapor deposition of diamond are presented. High power-density microwave plasmas in a high concentration of methane diluted by hydrogen led to high diamond growth rates at elevated substrate temperatures up to around 1450 C. With the addition of a small amount of oxygen (less than 2%), diamond films deposited at substrate temperatures higher than 1450 C at 30 microns/hr were achieved. At substrate temperatures higher than 1600 C, diamond nucleation density is low. However, diamond grows well and forms high quality diamond crystallites.
DTIC
Diamond Films; Vapor Deposition; Crystal Growth; Crystallization

19990054151 SensArray Corp., Burlington, MA USA
Doped PMN-PT Single Crystals ***Monthly Report, 18 Mar. - 17 Apr. 1999***
Gabbe, David R., SensArray Corp., USA; Cabanas-Holmen, Manuel F., SensArray Corp., USA; Apr. 17, 1999; 8p; In English
Contract(s)/Grant(s): N66604-99-C-0226
Report No.(s): AD-A362908; M0109-04; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The subject of this work is optimization and eventual scale-up of top-seeded solution growth (TSSG) of the title single crystals, leading to commercialization of the growth of device quality piezoelectric and electrostrictive materials for Naval as well

as civilian applications. Over the reporting period, three crystal growth runs have been completed. The effect of high purity feed chemicals, and crystal growth parameters on crystal quality is under investigation. An improvement in quality compared to the Phase I crystals has been obtained. A commercial laboratory capable of performing chemical analysis of 0.1 g samples has been selected. Fabrication specimens for in-house evaluation, chemical analysis and characterization under subcontract at MIT is in progress. Commercial stepping motor software running four independent motors has been extensively modified to meet the requirements of a crystal growth process. Two new crystal pullers are undergoing final testing.
DTIC
Doped Crystals; Crystal Growth; Crystallization; Single Crystals; Piezoelectric Crystals; Piezoelectricity; Electrostriction

19990054552 University of Electro-Communications, Dept. of Applied Physics and Chemistry, Tokyo, Japan
Piezoelectric Properties of La3Ta(0.5)Ga(5.5)O14 Single Crystal
Koyama, Shoji, University of Electro-Communications, Japan; Otsuhata, Satoshi, University of Electro-Communications, Japan; Uchino, Yukiko, University of Electro-Communications, Japan; Kameoka, Toshiyuki, University of Electro-Communications, Japan; Inoue, Koji, University of Electro-Communications, Japan; Takahashi, Kunishige, University of Electro-Communications, Japan; Sasaki, Yukihiko, University of Electro-Communications, Japan; Bulletin of the University of Electro-Communications; June 1998; Volume 11, No. 1, pp. 1-7; In Japanese; See also 19990054551; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Elastic stiffness constants and compliance constants of La3Ta(0.5)Ga(5.5)O14 (LTG) single crystal, grown by a Czochralskii method, have been obtained independently from ultrasonic velocities and piezoelectric resonance frequencies, respectively. Relative dielectric constants epsilon(11)/epsilon(0) and epsilon(33)/epsilon(0) are obtained as 20 and 75, respectively. Differences among velocities of longitudinal waves and transverse ones show larger value than those of quartz.
Author
Piezoelectricity; Gallium Oxides; Tantalum Compounds; Lanthanum Compounds; Single Crystals

19990054553 University of Electro-Communications, Dept. of Applied Physics and Chemistry, Tokyo, Japan
Piezoelectric Properties in alpha-, Incommensurate- and beta-Phases of Quartz SiO2
Ohya, Masaharu, University of Electro-Communications, Japan; Nisikawa, Tetsuhiro, University of Electro-Communications, Japan; Maeda, Tomoko, University of Electro-Communications, Japan; Mitsuhashi, Hideto, University of Electro-Communications, Japan; Sakai, Akiyoshi, University of Electro-Communications, Japan; Hokari, Koichiro, University of Electro-Communications, Japan; Sasaki, Yukihiko, University of Electro-Communications, Japan; Bulletin of the University of Electro-Communications; June 1998; Volume 11, No. 1, pp. 9-16; In Japanese; See also 19990054551; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

Piezoelectric properties of quartz SiO2 were obtained by a self-resonance method at 150-200 kHz over a range of room temperature to 960 C and in detail especially in the incommensurate phase. The large elastic anomalies were observed. Piezoelectricity was found to preserve up to 960 C. Temperature dependence of S11, S13, S14, S33 and S44, and relative dielectric constant epsilon(11)/epsilon(0) and tan delta has been obtained over a range of room temperature to 960 C. ”Tridymite phase” was not detected.
Author
Piezoelectricity; Quartz

77
THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also 25 Inorganic and Physical Chemistry and 34 Fluid Mechanics and Heat Transfer.

19990053699 Naval Postgraduate School, Dept. of Mechanical Engineering, Monterey, CA USA
Enhancement of Boiling in Highly Wetting Fluids
Tuite, Joseph M.; Mar. 1999; 118p; In English
Report No.(s): AD-A362878; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The boiling of a highly wetting dielectric fluid, in an oscillating environment, has been investigated. Because of low surface tension, these liquids require very high superheat to initiate nucleate boiling. This high degree of superheat required can be reduced by oscillation of the fluid. This oscillation removes the bubbles, which are forming in the nucleation sites on the wire, which allows new bubbles to form. The amplitude and frequency of the oscillation has been varied in an attempt to find optimum values. All attempted oscillation amplitudes and frequencies reduced the required superheat necessary to initiate nucleate boiling. Some

oscillation amplitudes and frequencies were more effective than others. No global optimum amplitude or frequency was specifically located. Several local optimum values were found. Once oscillation amplitude was found to produce equal required superheat values at various frequencies, thus appearing to be independent of frequency.
DTIC
Nucleate Boiling; Liquid Cooling; Boiling; Wetting

19990053738 Massachusetts Inst. of Tech., Lab. of Electronics, Cambridge, MA USA
Quantum Chaos in Rydberg Atoms ***Annual Report, 1 Jan. - 31 Dec. 1998***
Kleppner, Daniel; Apr. 30, 1999; 4p; In English
Contract(s)/Grant(s): N00014-96-1-0484
Report No.(s): AD-A362681; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have carried out a study of physics in the semiclassical regime. Recently we extended the technique of recurrence spectroscopy to the time domain. In separate experiment we investigated extending the semiclassical closed orbit theory to a process whose origin is entirely quantum mechanical: tunneling. We studied the continuum photoexcitation spectrum of Ryberg states of lithium in an electric field under conditions for which the escaping electron must tunnel through the potential barrier, and also for which it could escape over the barrier. We applied scaled energy spectroscopy to the system, making it possible to relate the spectrum to the classical orbits. When tunneling is important,new classical orbits can originate by an entirely non-classical process. It has turned out to be possible to understand the system theoretically and reproduce the spectrum in great detail, including both sharp tunneling resonances and broad above-barrier structures.
DTIC
Quantum Electronics; Tunneling; Electric Fields; Photoexcitation

81
ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

19990053732 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA
Why Reengineering Projects Fail
Bergey, John; Smith, Dennis; Tilley, Scott; Weiderman, Nelson; Woods, Steven; Apr. 1999; 37p; In English
Contract(s)/Grant(s): F19628-95-C-0003
Report No.(s): AD-A362725; CMU/SEI-99-TR-010; ESC*-TR-99-010; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this report is to highlight some of the most important reasons for failures in reengineering efforts despite the best of intentions. We support our observations with examples from a variety of experiences over many years. Readers may recognize some of the situations presented here and be tempted to conclude that the examples are taken from their own organizations, but similar missteps occur quite frequently.
DTIC
Software Engineering; Organizations; Management

19990054148 NASA Goddard Space Flight Center, Greenbelt, MD USA
Continuous Risk Management Course
Hammer, Theodore F., NASA Goddard Space Flight Center, USA; Jan. 1999; 254p; In English
Contract(s)/Grant(s): NAS5-32910; F19628-95-C-0003; Copyright Waived; Avail: CASI; A12, Hardcopy; A03, Microfiche

This document includes a course plan for Continuous Risk Management taught by the Software Assurance Technology Center along with the Continuous Risk Management Guidebook of the Software Engineering Institute of Carnegie Mellon University and a description of Continuous Risk Management at NASA.
CASI
Risk; Software Engineering; Textbooks; Management Analysis; Management Methods

82
DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.

19990053661 Michigan State Univ., East Lansing, MI USA
Information Technology Innovation in the U.S. Army: The Case of the Adoption, Adaptation, and Utilization of the Strategic Crisis Exercise Intranet
Jantzen, Linda C., Michigan State Univ., USA; Jan. 1999; 99p; In English
Report No.(s): AD-A362718; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

The U.S. Army has undergone dramatic changes in its structure and operating procedures in recent years as a result of the introduction of new information technologies. This study examines the adoption and adaptation of an information technology innovation in a U.S. Army organization. While previous studies have focused on the technologies themselves, this study investigates the process of innovation adoption, with special attention paid to how the technology and the organization influence each other.
DTIC
Information Systems; Technology Assessment; Strategic Materials; Armed Forces

19990053726 State Univ. of New York, Albany, NY USA
Practical Tools for Electronic Records Management and Preservation
Jan. 1999; 17p; In English
Report No.(s): AD-A362863; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents an easy to understand foundation for electronic records management considerations. It also presents practical tools that seamlessly integrate into the system design process and result in the identification of technical specifications and opportunities for improving performance through improved access to records. The tools also identify critical management and policy factors that must be in place to support a full system implementation. These tools can be used by any organization to: (1) Bring the record to the forefront of system design activities. (2) Identify electronic records functionality as part of system design. (3) Create electronic records that support legal and evidentiary needs. (4) Create electronic records that are accessible and usable over time. (5) Integrate diverse document forms and formats into records. (6) Identify need for internal and external primary and secondary access to records.
DTIC
Records Management; Preserving; Electronic Equipment

19990054128 State Univ. of New York, School of Information Science and Policy, Albany, NY USA
National Survey of US Public Library Outlet Internet Connectivity ***Final Report, 1998***
Bertot, J. C., State Univ. of New York, USA; McClure, C. R., Syracuse Univ., USA; Sep. 1998; 96p; In English
Report No.(s): PB99-121063; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The 1998 data studied all library outlets (defined as both central or system/administrative units and branches, excluding bookmobiles and 227 outlets for which it was not possible to determine the geocodes), the poverty level of the users served by these outlets, and the library's metropolitan status as urban, suburban, and rural. This comprehensive picture can provide the public library community, policy makers, and researchers with a more informed picture of which library outlets in different types of poverty and/or urban/rural settings provide what level and type of Internet connectivity. Such data provide an important benchmark describing how public library outlets support University Service objectives as legislated through the Telecommunications Act of 1996 (P.L. 104-104). The data can also inform policy makers as to possible future changes and impacts resulting from the disbursement of funds to these public library outlets in support of Universal Service objectives.
NTIS
Libraries; Internets; Information Dissemination

19990054523 Maryland Univ., College Park, MD USA
Proceedings of International Workshop on Advances in Multimedia Information Systems (4th) Held in Istanbul, Turkey on 24-26 September 1998
Subrahmanian, Venkatramanan S.; Jan. 14, 1999; 221p; In English
Contract(s)/Grant(s): DAAG-55-98-1-0330
Report No.(s): AD-A359486; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The purpose of the Workshop on Multimedia Information Systems was to explicitly address specific research problems articulated during the 1997 workshop held in Como, Italy. Therefore, the primary aim of the fourth international Workshop is to: (1) Develop theories of multimedia databases that address the questions identified in the third Workshop, and (2) Investigate the application of these theories to real life problems encountered in DoD and Commercial Sectors.
DTIC
Conferences; Information Systems

19990054590 Army War Coll., Carlisle Barracks, PA USA
Strategic Approach to Information Systems Protection
Heuler, Ronald R.; Apr. 07, 1999; 58p; In English
Report No.(s): AD-A363891; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The National Security Strategy (NSS) states that the national security posture is dependent on information infrastructure and its protection. Information and information systems have strategic value due to ubiquitous interconnection with national infrastructure. Because of the strategic implications, comprehensive protection of information systems is essential. Unfortunately, many Department of Defense (DoD) information systems are still being fielded without adequate consideration of this important aspect. Protection of information systems cannot be an afterthought. It must be integrated with the solution to information system requirements. This SRP examines a conceptual framework for the fielding of protected information systems for those involved in the planning, budgeting, design, implementation, operation, and support of DoD information systems.
DTIC
Information Systems; Strategy; Protection; Security

83
ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

19990053510 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne, Australia
An Econometric Model for HUMS Cost Benefit Studies
Forsyth, Graham, Defence Science and Technology Organisation, Australia; Workshop on Helicopeter Health and Usage Monitoring Systems; February 1999, pp. 75-88; In English; See also 19990053503; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., P.O. Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Contents include the following: graham forsyth; helicopter life assessment; airframes and engines div; and AMRL
CASI
Health; Management Systems; Cost Effectiveness

89
ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

19990053571 NASA Goddard Space Flight Center, Greenbelt, MD USA
The SERTS-97 Rocket Experiment on Study Activity on the Sun: Flight 36.167-GS on 1997 November 18
Swartz, Marvin, NASA Goddard Space Flight Center, USA; Condor, Charles E., NASA Goddard Space Flight Center, USA; Davila, Joseph M., NASA Goddard Space Flight Center, USA; Haas, J. Patrick, NASA Goddard Space Flight Center, USA; Jordan, Stuart D., NASA Goddard Space Flight Center, USA; Linard, David L., NASA Goddard Space Flight Center, USA; Miko, Joseph J., NASA Goddard Space Flight Center, USA; Nash, I. Carol, NASA Goddard Space Flight Center, USA; Novello, Joseph, NASA Goddard Space Flight Center, USA; Payne, Leslie J., NASA Goddard Space Flight Center, USA; Plummer, Thomas B., NASA Goddard Space Flight Center, USA; Thomas, Roger J., NASA Goddard Space Flight Center, USA; White, Larry A., NASA Goddard Space Flight Center, USA; Brosius, Jeffrey W., Raytheon STX Corp., USA; Thompson, William T., Space Applications Corp., USA; February 1999; 58p; In English; Original contains color illustrations
Report No.(s): NASA/TP-1998-208640; NAS 1.60:208640; Rept-99B00010; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This paper describes mainly the 1997 version of the Solar EUV Rocket Telescope and Spectrograph (SERTS-97), a scientific experiment that operated on NASA's suborbital rocket flight 36.167-GS. Its function was to study activity on the Sun and to pro-

vide a cross calibration for the CDS instrument on the SOHO satellite. The experiment was designed, built, and tested by the Solar Physics Branch of the Laboratory for Astronomy and Solar Physics at the Goddard Space Flight Center (GSFC). Other essential sections of the rocket were built under the management of the Sounding Rockets Program Office. These sections include the electronics, timers, IGN despin, the SPARCS pointing controls, the S-19 flight course correction section, the rocket motors, the telemetry, ORSA, and OGIVE.
Author
Sounding Rockets; Sun; Solar Radiation; Rocket Engines; Suborbital Flight; Extreme Ultraviolet Radiation; Telescopes; Spectrographs

19990054356 Hawaii Univ., Inst. for Astronomy, Honolulu, HI USA
Observations of Planet Crossing Asteroids ***Annual Report, 1 Mar. 1998 - 28 Feb. 1999***
Tholen, David J., Hawaii Univ., USA; May 17, 1999; 9p; In English
Contract(s)/Grant(s): NAG5-4524
Report No.(s): AD-A363404; Rept-6-54760; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
This grant funds the investigation of the Solar System's planet crossing asteroid population, principally the near Earth and trans-Neptunian objects, but also the Centaurs. Investigations include colorimetry at both visible and near infrared wavelengths, light curve photometry, astrometry, and a pilot project to find near Earth objects with small aphelion distances, which requires observations at small solar elongations.
DTIC
Interplanetary Trajectories; Asteroids; Light Curve; Photometry

90
ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also 75 Plasma Physics.

19990054479 Tokyo Inst. of Tech., Dept. of Applied Physics, Tokyo, Japan
Probing the universe by using pulsed keV neutrons
Nagai, Y., Tokyo Inst. of Tech., Japan; Proceedings of the international workshop on science in Neutron-arena of JHP; May 1996, pp. 60-64; In English; See also 19990054467; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche
Models of the stellar evolution and nucleosynthesis in stars in necessary to investigate the record of the Big Bang. The observed abundances of various elements in stars could be used to construct the models. Since the heavier elements than iron are considered to be synthesized by the neutron capture reaction of a nucleus in stars it is necessary to measure the reaction cross section at stellar temperature to estimate quantitatively the production of these elements. to this purpose pulsed keV neutrons from the JHP spallation source would be very useful.
Author
Neutrons; Stellar Evolution; Stellar Models; Capture Effect; Big Bang Cosmology; Iron; Metallicity; Chemical Composition; Pulsed Radiation; Neutron Sources

19990054646 Instituto Nacional de Pesquisas Espacias, Sao Jose dos Campos, Brazil
Methods of Determination of Periodicities in Astrophysical Data: Application to Object CZ Aquilae ***Metodos de Determinacao de Periodicidades em Dados Astrofisicos: Aplicacao ao Objecto CZ Aquilae***
Rezende, Carlos Eduardo Lohse, Instituto Nacional de Pesquisas Espacias, Brazil; 1999; 102p; In Portuguese
Report No.(s): INPE-7120-TDI/671; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
One way of studying an object in astrophysics is with the time series analysis, where we can characterize the behaviour of object in the past and future. to make this analysis, we use period determination methods. We applied five methods to the cataclysmic variable CZ Aquilae, with the goal to find their orbital period. Photometric and spectroscopic data were analyzed. The photometric data analysis found an orbital period of O.320273 day and the spectroscopic data analysis found an orbital period of 0.201528 day. We choiced the period found by spectroscopic data analysis because this showed good fits and the photometric data showed an indication of this period can be the period of the system. The CZ Aquilae spectrum, characterized by emission lines in H(alpha) (6562,8 k) and He I (5876 and 6678 A), besides the absorption lines attributed to diffuse interstellar bands, is typical of a dwarf nova, but we have suspects of this object can be a SW sex type (as the object don't presents eclipses and almost all SW Sex systems are eclipsing, it's difficult to make a more conclusive analysis). We still can say CZ Aquilae would not be a dwarf

nova of type SU UWa, because the SU UMa has short periods (more or less two hours). Another features of the system: it has a low galactic latitude, it has an estimated distance of 243 pc (but this value has great uncertainties). The mass of primary was estimated in the range 0.6 - 1.0 solar mass considering the mass of secondary with the value 0.48 solar mass. and the orbital inclination was estimated in the range 37 deg. - 53 deg..
Author
Astrophysics; Research; Cataclysmic Variables; Emission Spectra; Spectroscopic Analysis

91
LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.

19990053745 NASA Goddard Space Flight Center, Greenbelt, MD USA
Gaseous abundances and methane supersaturation in Titan's troposphere
Samuelson, Robert E., NASA Goddard Space Flight Center, USA; Nath, Nitya R., Hughes STX, Inc., USA; Borysow, Aleksandra, Michigan Technological Univ., USA; Planetary and Space Science; 1997; ISSN 0032-0633; Volume 45, No. 8, pp. 959-980; In English
Contract(s)/Grant(s): NAG5-4534; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Various properties of Titan's troposphere are inferred from an analysis of Voyager I infrared spectrometer (IRIS) data between 200 and 600/ cm. Two homogeneous spectral averages acquired at widely separated emission angles are chosen for the analysis. Both data sets are associated with northern low latitudes very close to that of the radio science ingress occultation point. Solutions require simultaneous nonlinear least-squares fits to the two IRIS data sets, coupled with iteration of the radio occultation refractivity data. Values and associated 1-sigma uncertainties of several parameters are inferred from our analysis. These include mole fractions for molecular hydrogen (approx. 0.0011), argon (small), and methane near the surface (approx. 0.057). Solutions are also obtained for the hydrogen parafraction (close to equilibrium, with considerable uncertainty), air temperature near the surface (approx. 93 K), surface surface temperature discontinuity (approx. 1 K), and maximum degree of methane supersaturation in the upper troposphere (approx. 1.5). Actual values for the above-mentioned parameters depend on the amount of ethane cloud near the tropopause. There is no evidence for methane clouds in the upper troposphere, nor is their presence compatible with large degrees of supersaturation. A wave number dependence for the stratospheric haze opacity is inferred similar to that found for a polymeric residue created in laboratory discharge experiments. This haze appears to be uniformly distributed with latitude between altitudes of 40 and 160 km, provided those nighttime data at southern high latitudes that are discounted.
Author
Hydrogen; Molecular Gases; Stratosphere; Abundance; Gas Analysis; Methane; Supersaturation; Troposphere

19990054436 Atmospheric and Environmental Research, Inc., Cambridge, MA USA
Comparative Studies for the Sodium and Potassium Atmospheres of the Moon and Mercury ***Final Report, 1 Feb. 1995 - 31 Jan. 1999***
Smyth, William H., Atmospheric and Environmental Research, Inc., USA; February 1999; 144p; In English; Original contains color illustrations
Contract(s)/Grant(s): NASw-4970
Report No.(s): P-542; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

A summary discussion of recent sodium and potassium observations for the atmospheres of the Moon and Mercury is presented with primary emphasis on new full-disk images that have become available for sodium. For the sodium atmosphere, image observations for both the Moon and Mercury are fitted with model calculations (1) that have the same source speed distribution, one recently measured for electron-stimulated desorption and thought to apply equally well to photon-stimulated desorption, (2) that have similar average surface sodium fluxes, about 2.8 x 10(exp 5) to 8.9 x 10(exp 5) atoms cm(exp -2)s(exp -1) for the Moon and approximately 3.5 x 10(exp 5) to 1.4 x 10(exp 6) atoms cm(exp -2)s(exp -1) for Mercury, but (3) that have very different distributions for the source surface area. For the Moon, a sunlit hemispherical surface source of between approximately 5.3 x 10(exp 22) to 1.2 x 10(exp 23) atoms/s is required with a spatial dependence at least as sharp as the square of the cosine of the solar zenith angle. For Mercury, a time dependent source that varies from 1.5 x 10(exp 22) to 5.8 x l0(exp 22) atoms/s is required which is confined to a small surface area located at, but asymmetrically distributed about, the subsolar point. The nature of the Mercury source suggest that the planetary magnetopause near the subsolar point acts as a time varying and partially protective shield

through which charged particles may pass to interact with and liberate gas from the planetary surface. Suggested directions for future research activities are discussed.
Author
Mercury (Planet); Moon; Potassium; Sodium; Mercury Atmosphere; Lunar Atmosphere

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SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see 93 Space Radiation.

19990053833 Communications Research Lab., Tokyo, Japan
Solar-Wind-Driven PC 3 and PI 3 Pulsations in the Magnetosphere
Matsuoka, Hitoshi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; Dec. 1997; Volume 43, No. 4, pp. 717-718; Repr. from Journal of the Communications Research Laboratory, v. 44, no. 2 Jul. 1997; In English; See also 19990053822; No Copyright; Avail: CASI; A01, Hardcopy; A02, Microfiche; Abstract Only; Abstract Only

This study investigated two types of magnetospheric ULF pulsations, Pc 3 and Pi 3, using multipoint measurements of magnetic field from satellites and ground stations. It is important to clarify the properties of these pulsations if we are to understand the global response of the magnetosphere to changes in the solar wind plasma with different spatial and temporal scales. It is also important to investigate the propagation mechanisms of these pulsations in order to understand the general properties of MHD waves propagating in inhomogeneous plasmas. The Pc 3 and Pi 3 pulsations are chosen here to represent solar wind input to the magnetosphere at two extremes of the MHD temporal and spatial scales. Pc 3 pulsations represent the short-time-scale input, with wavelengths comparable to the inhomogeneity scale or the dimensions of the dayside magnetosphere. Pi 3 pulsations represent the large-time-scale input, with wavelengths far exceeding the dimension of the dayside magnetosphere, The first part of this work investigates the amplitude and phase structure of Pc 3 pulsations. Although these pulsations are observed at various latitudes, there had been no systematic studies of their phase and amplitude structure over a wide range of latitudes. Magnetic field data from the Western Pacific magnetometer array centered at 210 deg. geomagnetic longitude and from the GEOTAIL satellite are used here to reveal the latitudinal structure of a Pc 3 pulsation event that occurred on October 17-18, 1992. During this event, GEOTAIL was located in the dayside magnetosphere at a radial distance of approx. 8 R(sub E) and observed tailward-propagating fast-mode magnetosonic waves in the Pc 3 band. Pulsations observed at the ground stations, also on the dayside, exhibited dynamic spectra similar to those observed on board GEOTAIL. Spectral analyses of the ground magnetometer data reveal that the pulsations are often coherent from L approx. 1 to L approx. 6 and that the phase of the pulsations varies with L in a complex manner: at low-latitude stations (1, between 1.1 and 2.9), there is little phase. delay; at a high-latitude station (L = 5.5) the phase relative to that at low latitudes is approx. 180 deg. and at an equatorial station (L = 1.01) the phase relative to that at low latitudes is approx. 150 deg. The pulsation amplitude is greatest at the highest-latitude station of the magnetometer array, but two local maxima occur at L approx. 1 and at L approx. 2.1. MHD wave propagation effects in the magnetosphere are examined here in order to explain these observations. The second part of the present work explores the generation and propagation properties of Pi 3 pulsations, Compressional Pi 3 magnetic pulsations with irregular waveforms and periods greater than 150 s have been studied by using data from the Active Magnetospheric Particle Tracer Explorers Charge Composition Explorer (AMPTE/CCE) satellite and GOES 5 and 6 satellites in the dayside magnetosphere and comparing this data with signatures of geomagnetic field variations on the ground at a low latitude (L = 1.25). On the ground the pulsations appear in the horizontal component. A study of 17 such concurrent events during a 2-month period in 1986 reveals the following: (1) The peak-to-peak amplitudes in the magnetosphere ((delta)B(sub T)) and on the ground ((delta)H) are comparable and are between 0.5 and 7 nT. (2) On the ground the pulsations can be seen at all local times, even at midnight, while at geostationary orbit they are observed only on the dayside and have a clear amplitude maximum at noon. (3) The pulsations on the ground lag those observed by CCE near local noon, and the lag increases with increasing local time difference between CCF and the ground station. The time lag is 1-2 min longer when the ground station is on the nightside than when it is on the dayside. (4) The time lag between pulsations observed at geostationary orbit and near noon by CCE varies systematically with local time and is about 2 min per 6 hours of local time difference.
Author
Solar Wind; Research; Magnetoacoustic Waves; Magnetohydrodynamic Waves; Data Acquisition; Geomagnetic Tail; Spectrum Analysis; Wave Propagation

19990054146 NASA Marshall Space Flight Center, Huntsville, AL USA
Chromospheric and Coronal Structure of Polar Plumes, 1, Magnetic Structure and Radiative Energy Balance
Allen, Maxwell J., Stanford Univ., USA; Oluseyi, Hakeem M., Stanford Univ., USA; Walker, Arthur B. C., Stanford Univ., USA;

Hoover, Richard B., NASA Marshall Space Flight Center, USA; Barbee, Troy W., Jr., Lawrence Livermore National Lab., USA; Solar Physics; 1997; Volume 174, pp. 367-401; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The Multi-Spectral Solar Telescope Array (MSSTA), a rocket-borne solar observatory, was successfully launched from White Sands Missile Range, New Mexico, on May 13, 1991 at 19:05 UT. The telescope systems onboard the MSSTA obtained several full disk solar images in narrow bandpasses centered around strong soft X-ray, EUV, and FUV emission lines. Each telescope was designed to be sensitive to the coronal plasmas at a particular temperature, for seven temperatures ranging from 20,000 K to 4,000,000 K. We report here on the images obtained during the initial flight of the MSSTA, and on the chromospheric and coronal structure of polar plumes observed over both poles of the Sun. We have also co-aligned the MSSTA images with Kitt Peak magnetograms taken on the same day. We are able to positively identify the magnetic structures underlying the polar plumes we analyze as unipolar. We discuss the plume observations and present a radiative energy balance model derived from them.
Author

Plumes; Coronas; Chromosphere; Solar Observatories; Telescopes; X Rays; Magnetic Field Configurations

19990054464 Helsinki Univ. of Technology, Kylmaelae Finland

Dynamics of Energy Release in Single Flare Loop

Zaitsev, V. V.; Urpo, S.; Stepanov, A. V.; 1999; 26p; In English

Report No.(s): PB99-135972; HUT-MET-29; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

Pulsating and explosive time profiles of mm-wave solar bursts observed at Metsahovi in terms of the energy release in single current-carrying loop are explained. We suppose that the electric current in a loop is driven by the photospheric convective flows. The flare occurs due to the flute instability which gives the penetration of partially ionized plasma of the chromosphere into the current channel of a loop and consequently the loop resistance grows by 8-10 orders of magnitude. The feedback of the deviation of the loop magnetic field on the energy release rate was taken into account. Two regimes of energy release are studied: (1) Pulsating energy release in rarefied current loop with plasma beta is much less than 1; (2) Explosive energy release in a loop with the gradient of gas pressure of about Ampere force. We have shown that using two mentioned regimes and its combination one can explain different time behavior of the flares, for example, several quasi-periodic pulses, and pulsations with increasing amplitude at pre-flash phase followed by explosive enhancement of the emission at flash phase.
NTIS

Solar Flares; Coronal Loops; Solar Radio Bursts; Solar Wind; Unsteady Flow; Convective Flow; Energy Dissipation

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GENERAL

19990053708 NASA, Washington, DC USA

Managing the Moon Program: Lessons Learned from Project Apollo

July 1999; 52p; In English; Oral History, 21 Jul. 1989, Unknown

Report No.(s): NASA/NP-1999-6-250-HQ; NAS 1.83: 6-250-HQ; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

There have been many detailed historical studies of the process of deciding on and executing the Apollo lunar landing during the 1960s and early 1970s. From the announcement of President John F Kennedy on May 25, 1961, of his decision to land an American on the Moon by the end of the decade, through the first lunar landing on July 20, 1969, on to the last of six successful Moon landings with Apollo 17 in December 1972, NASA carried out Project Apollo with enthusiasm and aplomb. While there have been many studies recounting the history of Apollo, at the time of the 30th anniversary of the first lunar landing by Apollo 11, it seems appropriate to revisit the process of large-scale technological management as it related to the lunar mission. Consequently, the NASA History Office has chosen to publish this monograph containing the recollections of key partcipants in the management process. The collective oral history presented here was recorded in 1989 at the Johnson Space Center's Gilruth Recreation Center in Houston, Texas. It includes the recollections of key participants in Apollo's administration, addressing issues such as communication between field centers, the prioritization of technological goals, and the delegation of responsibility. The following people participated: George E. Muller, Owen W. Morris, Maxime A. Faget, Robert R. Gilruth, Christopher C. Kraft, and Howard W. (Bill) Tindall. The valuable perspectives of these individuals deepen and expand our understanding of this important historical event. This is the 14th in a series of special studies prepared by the NASA History Office. The Monographs in Aerospace History series is designed to provide a wide variety of investigations relative to the history of aeronautics and space. These

publications are intended to be tightly focused in terms of subject, relatively short in length, and reproduced in an inexpensive format to allow timely and broad dissemination to researchers in aerospace history.
Derived from text
Lunar Landing; Apollo 11 Flight; Manned Spacecraft; Apollo Project

19990053741 Air Force Academy, CO USA
USAFA Discovery, Jan-Mar 99
Mar. 1999; 12p; In English
Report No.(s): AD-A362648; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
CONTENTS: Cadets Begin Fabrication of Satellite for Launch; Designing-High-Speed Vehicles for the U.S. Air Force; and, Department Research News.
DTIC
Periodicals; Launching; Military Technology

19990054149 NASA, Washington, DC USA
NASA Historical Data Book, Volume 5, NASA Launch Systems, Space Transportation, Human Spaceflight and Space Science, 1979-1988
Rumerman, Judy A., Compiler, NASA, USA; 1999; 548p; In English
Contract(s)/Grant(s): NASw-3597
Report No.(s): NASA/SP-1999-4012/VOL5; NAS 1.21:4012/VOL5; ISBN 0-16-050030-3; No Copyright; Avail: CASI; A23, Hardcopy; A04, Microfiche
In 1973, NASA published the first volume of the NASA Historical Data Book, a hefty tome containing mostly tabular data on the resources of the space agency between 1958 and 1968. There, broken into detailed tables, were the facts and figures associated with the budget, facilities, procurement, installations, and personnel of NASA during that formative decade. In 1988, NASA reissued that first volume of the data book and added two additional volumes on the agency's programs and projects, one each for 1958-1968 and 1969-1978. NASA published a fourth volume in 1994 that addressed NASA resources for the period between 1969 and 1978. This fifth volume of the NASA Historical Data Book is a continuation of those earlier efforts. This fundamental reference tool presents information, much of it statistical, documenting the development of four critical areas of NASA responsibility for the period between 1979 and 1988. This volume includes detailed information on the development and operation of launch systems, space transportation, human spaceflight, and space science during this era. As such, it contains in-depth statistical information about the early Space Shuttle program through the return to flight in 1988, the early efforts to build a space station, the development of new launch systems, and the launching of seventeen space science missions. A companion volume will appear late in 1999, documenting the space applications, support operations, aeronautics, and resources aspects of NASA during the period between 1979 and 1988. NASA began its operations as the nation's civilian space agency in 1958 following the passage of the National Aeronautics and Space Act. It succeeded the National Advisory Committee for Aeronautics (NACA). The new organization was charged with preserving the role of the USA "as a leader in aeronautical and space science and technology" and in its application, with expanding our knowledge of the Earth's atmosphere and space, and with exploring flight both within and outside the atmosphere. By the 1980s, NASA had established itself as an agency with considerable achievements on record. The decade was marked by the inauguration of the Space Shuttle flights and haunted by the 1986 Challenger accident that temporarily halted the program. The agency also enjoyed the strong support of President Ronald Reagan, who enthusiastically announced the start of both the Space Station program and the National Aerospace Plane program.
Derived from text
NASA Space Programs; Histories; Technology Utilization; Space Transportation; Spacecraft Launching; Manned Space Flight; Aerospace Sciences

19990054617 NASA, Washington, DC USA
Dreams, Hopes, Realities: NASA's Goddard Space Flight Center, the First Forty Years
Wallace, Lane E.; 1999; 232p; In English; Original contains color illustrations
Report No.(s): NASA/SP-1999-4312; NAS 1.21:4312; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche
Throughout history, the great achievements of civilizations and cultures have been recorded in lists of dates and events. But to look only at the machinery, discoveries, or milestones is to miss the value of these achievements. Each goal achieved or discovery or made represents a supreme effort on the part of individual people who came and worked together for a purpose greater than themselves. Driven by an innate curiosity of the spirit, we have built civilizations and discovered new worlds, always reaching out beyond what we knew or thought was possible. These efforts may have used ships or machinery, but the achievement was that

of the humans who made those machines possible- remarkable people willing to endure discomfort, frustration, fatigue, and the risk of failure in the hope of finding out something new. This is the case with the history of the Goddard Space Flight Center. This publication traces the legacy of successes, risks, disappointments and internationally recognized triumphs of the Center's first 40 years. It is a story of technological achievement and scientific discovery; of reaching back to the dawn of time and opening up a new set of eyes on our own planet Earth. In the end, it is not a story about machinery or discoveries, but a story about ourselves. If we were able to step off our planet, and if we continue to discover new mysteries and better technology, it is because the people who work at Goddard always had a passion for exploration and the dedication to make it happen. The text that follows is a testimony to the challenges people at the Goddard Space Flight Center have faced and overcome over almost half a century. Today, we stand on the threshold of a new and equally challenging era. It will once again test our ingenuity, skills, and flexibility as we find new ways of working with our colleagues in industry, government, and academia. Doing more with less is every bit as ambitious as designing the first science instrument to study the heavens. But if we are to continue exploring our world and our universe, it is every bit as important. Robert H. Goddard once said, "The dream of yesterday is the hope of today and the reality of tomorrow." This is our heritage. Our challenge is to keep our spirit of dedication, vision, and innovative thinking alive, so we can turn today's dreams into a new century of possibility and progress. Our journeys into space are the greatest ongoing adventure the human race has ever undertaken, and everyone here has played an important role in that endeavor. This book is about everyone who has worked at the Goddard Space Flight Center.

Derived from text

Histories; NASA Space Programs; Research Facilities; Documentation

Subject Term Index

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